B.E. (Electronics and Instrumentation Engineering)

2015 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai

Approved by AICTE - Accredited by NBA New Delhi, NAAC with 'A' Grade and ISO 9001:2008 Certified)

SATHYAMANGALAM – 638 401 Erode District Tamil Nadu

Phone : 04295 226000 Fax : 04295 226666

Web:www.bitsathy.ac.in E-mail : stayahead@bitsathy.ac.in

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REGULATIONS 2015

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2015 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2015 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2015-2016 for Regular admission (Academic year 2016-2017 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

- Higher Secondary Examination (10 +2) of Curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / Directorate of Technical Education (DoTE), Chennai as equivalent thereto.

(or)

- Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for Lateral Entry admission to the third semester of B.E. / B.Tech. Programmes in the branch of study as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time.

(or)

1.2.2 The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for Lateral Entry admission to the third semester of B.E./B.Tech. Programmes, as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

i. Aeronautical Engineering
ii. Agricultural Engineering
iii. Automobile Engineering
iv. Civil Engineering
v. Computer Science and Engineering
vi. Electrical and Electronics Engineering
vii. Electronics and Communication Engineering
viii. Electronics and Instrumentation Engineering
ix. Mechanical Engineering
x. Mechatronics

B. Tech. Programmes

i. Biotechnology
ii. Fashion Technology
iii. Information Technology
iv. Textile Technology
v. Food Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, mini-project, life-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

(i) **Basic Science** courses including Mathematics, Physics, Chemistry and further specialization in these subjects

(ii) **Basic Engineering c**ourses including Engineering Graphics, Workshop Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science c**ourses including Language Courses, Management Courses, Life Skills and Professional Ethics.

(iv) **Professional Courses** include Discipline Core Courses, Professional Electives, Core Electives and Open Electives.

(v) **Employability Enhancement Courses (EEC)** include Project Work and /or Internship, Seminar, Industrial /Practical Training, Value Added and Certificate Courses.

The assortment of different courses shall be designed that the student, at the end of the programme, would be able to be trained not only in his / her relevant professional field but also as a socially mindful human being.

The medium of instruction is English for all the Courses, Examinations, Seminar Presentation, Projects and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits, with 1 credit per lecture period per week, 1 credit for 2 periods of tutorial, 1 credit for 2 periods of laboratory courses, and 1 credit for 2 periods of seminar/project work per week.

3.3 A Diagnostic Test will be administered to all the B.E. / B.Tech. students after the admission to assess the proficiency in English and based on the score they will be brought under two streams namely, Stream A and Stream B. Students under Stream A will study **Communicative English I** and Stream B will study **Basic English I** under Language Elective I in the First Semester. In the Second Semester, Stream A will be further divided into two categories based on their English language proficiency assessed in the Continuous Assessment, while the upper segment can enroll and study **German / Japanese / French / Chinese / Hindi** and the remaining students of that Stream will study **Communicative English II**. The students under Stream B will study **Basic English II** or may opt for **Communicative English II** based on the assessment carried out at the end of the semester I.

3.4 Every student shall be required to opt for **Nine** electives from the list of electives. Students can opt for the electives (Core / Professional / Open Elective) from any branch of B.E/B.Tech. Programmes, besides his / her own discipline courses, during V to VIII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of three electives as open electives from the list of open electives of the branch / branches other than his / her branch of specialisation. There shall be no pre-requisite course(s) for such open electives.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hour duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VII as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other Departments, provided the student has fulfilled the necessary pre-requisites or the courses that may not require any pre-requisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any Department / Centre and a maximum batch size for a given course shall not exceed 40. In the case of disciplines with multiple divisions (intake more than 60) different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, Credits will be indicated in the Grade Sheet, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the Electives (other than open elective) of the Semester VIII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VIII Semester, following the equivalence norm, that **one regular elective (**in the **VIII Semester)** is equivalent to **three one-credit courses** completed by the student during the previous semesters, IV to VII. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However one credit courses completed during I to III semesters shall be maintained in the Grade sheet as “Additional credits earned” (not considered for the computation of GPA/CGPA).

3.7 Fast Track System shall enable students to undergo a semester-long Internship or Special Training during Semester VIII. A student who secures a minimum CGPA of 8.50 in Semester IV with no current arrears, as on that date and maintains the CGPA of 8.50 till VI Semester without any arrears shall be eligible to opt for Fast Track System and such student is required to complete three elective courses satisfactorily, while completion of Semester VII, as additional Credits during the semesters V to VII.

3.8 Every student shall be required to carry out a Project Work in the Department / Industry or by exercising Fast track during VIII Semester in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the VIII Semester for the valuation.

3.9 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not be considered for computing the CGPA.

3.10 A Student may be permitted to credit online courses with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. Such students may be exempted from attending the classes, if such course(s) are offered in the semester. Summary of such on-line courses, taken by the students, along with the offering agency shall be presented to the Academic Council for information and further suggestions. However, those students need to obtain certification from the agency / agencies offering the course, to become eligible for writing or seeking exemption (core elective course) from the End Semester Examination. In case of credits earned through online mode, from the other Institute / University, the credits may also be transferred directly after due approval from the Departmental Consultative

Committee and the Office of the Controller of Examinations. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Discipline elective or Open elective).

4. VALUE ADDED COURSES / ADD-ON COURSES

A Student can opt for the Value Added Courses / Add-on Courses offered by the various Department / Centres for which the batch size will not exceed 40 per course from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 Semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 90 working days or 450 periods of 60 minutes each or equivalent. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified

(Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a Faculty Advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum in** the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In the case, if a student fails to register in the course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

6.4.1 A student has to earn the total number of credits specified in the Curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one- credit courses, self study electives or additional courses.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. Total number of credits of such courses cannot exceed 6 in a given Semester. However the maximum number of credits that a student can register in a particular semester shall not exceed 30 credits (regardless to the reappearance credits). In such cases, the attendance requirement as stated Clause 7 is mandatory.

6.4.3 The minimum number of credits that a student can register in a particular semester shall not be less than 18 credits (except VII / VIII semester).

6.4.4 The student shall register for the project work in the VIII semester only.

6.5 Reappearance Registration

6.5.1 If a student fails in a theory course, the student shall do reappearance registration (Examination) for that course in the subsequent semesters or when it is offered next.

6.5.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any Laboratory Course/ Project work / Seminar or any other EEC courses (Specified in Clause 3.1) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance (Physical presence) course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/ International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 In the case of reappearance registration for a course (vide Clause 6.5), the student has to register for examination in that course by paying the prescribed fee.

7.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a Faculty member of the Department who shall function as Faculty Advisor for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty including the discipline with multiple divisions (greater than or equal to 2) shall have a “Common Course Committee” comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester.

First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of one credit courses / certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and practical including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.

10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2. Supplementary Examinations may also be conducted, at such times, for the benefit of the students as decided by the Controller of Examinations.

10.4 For the End Semester examinations, both theory and practical courses including project work, the internal and external examiners (from Academia or Industry) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination and Evaluation Board of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 A student who secures not less than 50% of total marks prescribed for a course, vide Clause 16, comprising a minimum of 50% of the marks prescribed for the End Semester Examination, shall be declared to have passed the course successfully and earned the prescribed credits for that course, applicable for all registered courses.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall register and reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a ‘Pass’.

11.1.2 Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester Examinations.

11.2 The minimum number of total credits to be earned by a student to qualify for the award of Degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	Minimum Credits	
	Regular Admission	Lateral Entry
B.E. Programmes		
Aeronautical Engineering	178	134
Agricultural Engineering	177	133
Automobile Engineering	179	134
Civil Engineering	176	131
Computer Science and Engineering	176	131
Electrical and Electronics Engineering	176	132
Electronics and Communication Engineering	177	132
Electronics and Instrumentation Engineering	177	133
Mechanical Engineering	179	135
Mechatronics	177	133
B.Tech. Programmes		
Biotechnology	175	131
Fashion Technology	176	132
Information Technology	176	131
Textile Technology	175	131
Food Technology	175	131

11.2.1 Student Migration and Credit Transfer: Normalization of the Credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of Institution, if a student migrates from other institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.3 A student shall be declared to have qualified for award of B.E/B.Tech. Degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and number credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.3), while the Letter Grade is an index of the performance of a student in a said course.

12.3 The performance of a student will be reported using Letter Grades, each carrying certain points as detailed below:

Range of Total Marks (as specified in Clause 16) / Specific Reason	Grade Points	Letter Grade
91 to 100	10	O (Outstanding)
81 to 90	9	A + (Excellent)
71 to 80	8	A (Very Good)
61 to 70	7	B + (Good)
50 to 60	6	B (Above average)
0 to 49	0	RA (Reappearance Registration)
Incomplete	0	I
Withdrawal	0	W
Absent	0	AB
Shortage of Attendance	0	SA

‘RA’ ---Reappearance registration is required for that particular course

‘I’ --- Continuous evaluation is required for that particular course in the subsequent examinations.

‘SA’ --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.4 After completion of the evaluation process, Grade Point Average (GPA), and the Cumulative Grade Point Average (CGPA) is calculated using the formula:

$$GPA/CGPA = \frac{\sum_{1}^{n} C_i * g_i}{\sum_{1}^{n} C_i}$$

where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of GPA and all the semesters, under consideration, in the case CGPA.

12.5 A student who does not appear for the End Semester Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.6 For the non credit courses Grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of GPA/CGPA.

12.7 **Photocopy / Revaluation:** A student, who seeks the re-valuation of the answer script is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s), within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the Department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless to the period of Break-of-study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 **First Class with Distinction**: A student who qualifies for the award of the Degree having passed all the courses of study of all the Eight Semesters (six semesters for lateral entry students) at the first opportunity, after the commencement of his / her study and securing a CGPA not less than 8.50 (vide clause 12.3) shall be declared to have passed with **First Class with Distinction**.

13.2 **First Class**: A student who qualifies for the award of the Degree having passed all the courses of study of all the eight semesters (six semesters for lateral entry students) after the commencement of his / her study and securing a CGPA not less than 6.50 shall be declared to have passed with **First Class** (not exceeded the total duration as specified in the Clause 5).

13.3 **Second Class**: All other students who qualify for the award of the Degree shall be declared to have passed in **Second Class.**

13.4 Course Completion Certificate shall be given to a student, provided he / she should have registered all the courses and also registered for the examinations in those courses (subject to Clause 6.0 and 7.0).

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if such request for withdrawal is made prior to the submission of the Continuous Assessment marks of the course(s) with the recommendations from the Head of the Department.

14.3 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break-of-study (for one academic semester or 6 months, whichever is earlier). However, a student detained for want of minimum attendance requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to rejoin the programme after the break shall be governed by the rules and regulations of DoTE and the Curriculum and Regulations in force at the time of rejoining, subject to the Clause 11.2.1.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of Degree (vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break-of-study may be granted by the Head of the Institution for a period not more than one year (total duration or two semesters whichever is earlier) in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended Break of Study, the name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Test I (15)	
	Test II (15)	
	Open book test (10)	
	Library - Seminars / Assignments (Two) (10)	
	End Semester Examination	**50**
	Total Marks	**100**

II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Test I (10)	
	Test II (10)	
	Conduct of Experiment	
	Preparation(5)	
	Experiment and Results (5)	
	Record Note#	
	Final Lab Examination (20)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**

III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (5)	
	ii. Experiment and Results (10)	
	iii. Record / Observation# (5)	
	Test – Cycle I (15)	
	Test – Cycle II (15)	
	End Semester Examination	
	Experiments & Results (40)	**50**
	Viva Voce – (10)	
	Total Marks	**100**

Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department

IV	**TECHNICAL SEMINAR**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Presentation I (25)	
	Presentation II (25)	
	End Semester Examination	
	Report# (20) *Presentation (20)* *Viva voce (10)*	**50**
	Total Marks	**100**
V	**PROJECT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Literature survey (10)	
	Problem Identification (5)	
	Methodology (10)	
	Review II	
	Continuation in Methodology (10)	
	Results / Progress (15)	
	End Semester Examination	
	Report# (20) *Presentation (20)* *Viva voce (10)*	**50**
	Total Marks	**100**
VI	**LANGUAGE ELECTIVE (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test 1 *Listening (10)* *Speaking (5)* *Reading (5)* *Writing (5)*	**25**
	Test 2 *Listening (10)* *Speaking (5)* *Reading (5)* *Writing (5)*	**25**
	Oral Exam	**50**
	Total Marks	**100**

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VII	**ONE-CREDIT COURSE**	**Marks**
	Test	**30**
	Quiz	**20**
	Final Examination	**50**
	Total Marks	**100**

VIII	**MINI-PROJECT**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Review I	**25**
	Review II	**25**
	Project Evaluation	
	Report (25)#	**50**
	Presentation&Viva Voce (25)	
	Total Marks	**100**

IX	**LIFE SKILLS**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory/Not Satisfactory)	

X	**VALUE ADDED / CERTIFICATE COURSES**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory / Not Satisfactory)	

XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Class work (based on attendance) (5)	
	Assignments (Minimum 8 Assignments) (20)	
	Model Examination (25)	
	End Semester Examination	**50**
	Total Marks	**100**

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Optional Test: *A student becomes eligible to appear for the one optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.*

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

Heads of Departments, in order to provide the experiential learning to the students, shall take efforts to arrange at least two industrial visits / field visits in a semester. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

18. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year, failing which he/she shall not be permitted to appear for the End Semester examinations of semester II and there onwards. Such students are permitted to appear for the End Semester examinations of semester II and there onwards only after completing satisfactorily the requirements.

The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

19. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

The Question Paper pattern (Theory Examination) for UG Programme is given below:

PART A		
Objective Type Questions: 20	**(20X1 = 20 Marks)**	**20**
PART B		
Short Answer Questions: 10	**(10X2 = 20 Marks)**	**20**
PART C		
Long Answer Questions: 5	**(5X12 = 60 Marks)**	**60**

	Total	**100**

PROGRAMME EDUCATIONAL OBJECTIVIES (PEOs)

After few years (3 to 5 years) of graduation, our graduates are expected to

I Work in multidisciplinary engineering automation domain, allied industries, software companies and academic institution.

II Pursue their higher studies/research at the reputed institution in India /abroad

III Have the Social Responsibility, Team Work Skill, Leadership Capabilities and Lifelong learning in their Professional Field and also become entrepreneurs

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

a. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

c. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

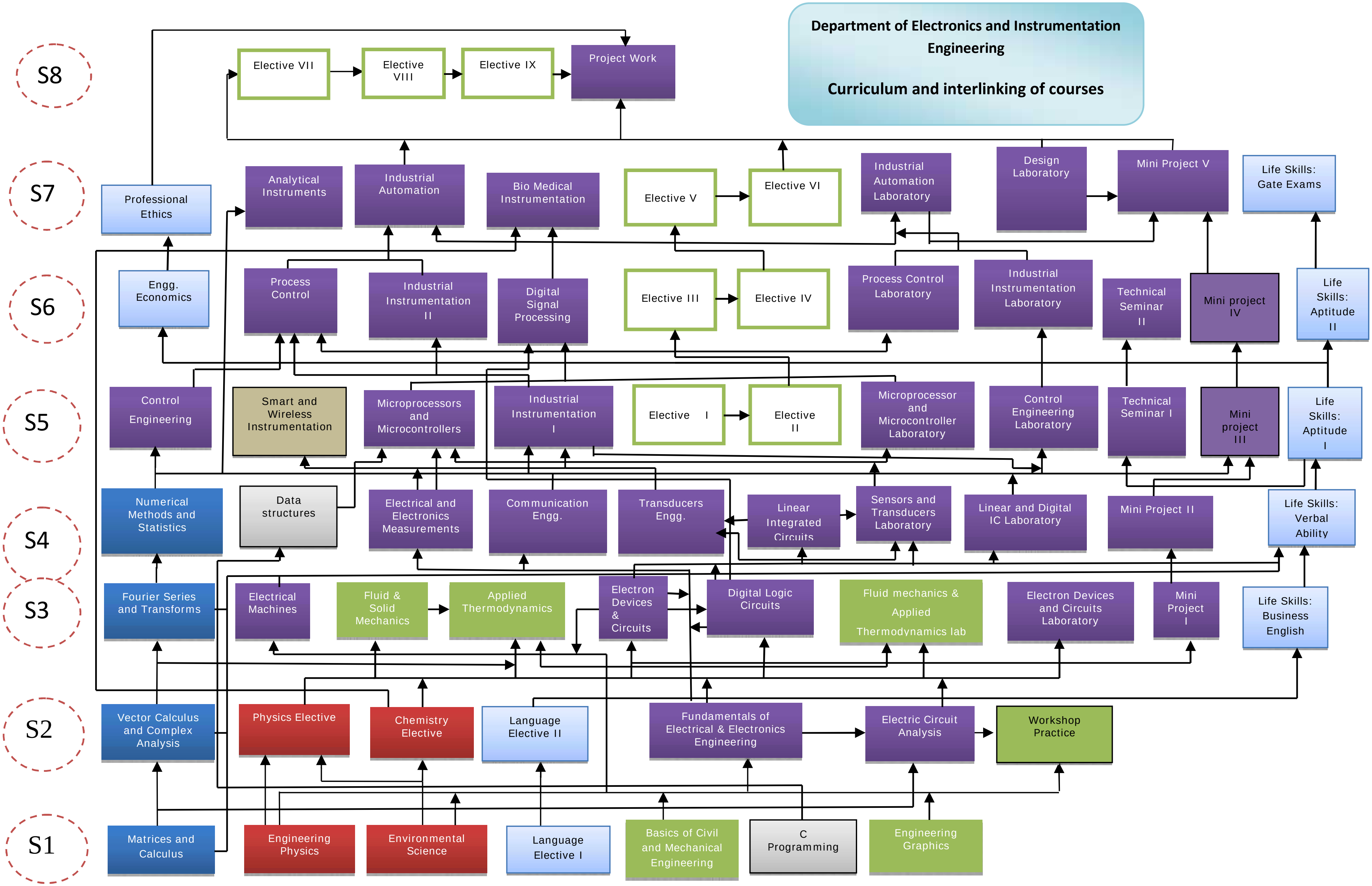
PROGRAMME SPECIFIC OUTCOMES (PSO’S)

m. Exploit sensors to measure physical quantities and design signal conditioning circuits.

n. Apply instrumentation systems and advanced controllers for automation

MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
PEO1	X	X	X		X					X			X	
PEO2	X	X		X			X			X				X
PEO3					X	X	X	X	X	X	X	X	X	X



General Electives (I to IX) are the courses offered by the department.

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING
Minimum Credits to be Earned :177

FIRST SEMESTER

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA101	MATRICES AND CALCULUS*	I,II,III	a,b	3	2	0	4	50	50	100	BS
15PH102	ENGINEERING PHYSICS*		a,b	2	0	2	3	50	50	100	BS
15CH103	ENVIRONMENTAL SCIENCE*	I,II,III	a,b,c,f,g	2	0	2	3	50	50	100	HSS
	LANGUAGE ELECTIVE I	-	-	-	-	-	3	100	-	100	HSS
15GE205	BASICS OF CIVIL AND MECHANICAL ENGINEERING⊕	-	a,g	3	0	0	3	50	50	100	ES
15GE106	C PROGRAMMING±	I,II,III	a,b,e	3	0	2	4	50	50	100	ES
15GE207	ENGINEERING GRAPHICSλ	-	a,f,h,j,l	0	0	4	2	50	50	100	ES
			Total	**13**	**2**	**10**	**22**	**400**	**300**	**700**	**-**

SECOND SEMESTER

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA201	VECTOR CALCULUS AND COMPLEX ANALYSIS*	I,II,III	a,b	3	2	0	4	50	50	100	BS
	PHYSICS ELECTIVE*	-	-	-	-	-	4	50	50	100	BS
	CHEMISTRY ELECTIVE*	-	-	-	-	-	4	50	50	100	BS
	LANGUAGE ELECTIVE II#	-	-	-	-	-	3	100	-	100	HSS
15EE205	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERINGΔ	I,II,III	a,b,m,n	3	0	0	3	50	50	100	ES
15EE206	ELECTRIC CIRCUIT ANALYSISΔ	I,II,III	a,b,d,e,n	2	0	2	3	50	50	100	ES
15GE107	WORKSHOP PRACTICEΩ	-	a,e,i,k,n	0	0	2	1	50	50	100	ES
			Total	**5**	**0**	**4**	**22**	**400**	**300**	**700**	**-**

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*Common to all branches of B.E./B.Tech
⊕Common to CSE,ECE,EEE,EIE,FT,IT (I Semester) and to MTRS, BT,TT, FD (II Semester)
±Common to CSE,ECE,EEE,EIE,IT
λCommon to CE,CSE,ECE,EEE,EIE,IT(I Semester) and to AE, AG,AU,ME,MTRS,BT,FT,TT ,FD (II Semester)
ΔCommon to EEE and EIE
ΩCommon to AE, AG,AU,ME,MTRS,BT,FT,TT,FD (I Semester) and to CE,CSE,ECE,EEE,EIE,IT (II Semester)

THIRD SEMESTER

Code No.	Course	Objectives & Outcomes: PEOs	Objectives & Outcomes: POs	L	T	P	C	Maximum Marks: CA	Maximum Marks: ES	Maximum Marks: Total	Category
15MA301	FOURIER SERIES AND TRANSFORMS$^{\alpha}$	I,II,III	a,b	3	2	0	4	50	50	100	BS
15EI302	ELECTRICAL MACHINES	I,II,III	a,b,d	2	0	2	3	50	50	100	PC
15EI303	FLUID AND SOLID MECHANICS	I,II,III	a,c,d	3	0	0	3	50	50	100	ES
15EI304	APPLIED THERMODYNAMICS	I,II,III	a,c	3	0	0	3	50	50	100	ES
15EI305	ELECTRON DEVICES AND CIRCUITS	I,II,III	a,b,c,d	3	2	0	4	50	50	100	PC
15EI306	DIGITAL LOGIC CIRCUITS	I,II,III	a,b,c,d,f,m	3	2	0	4	50	50	100	PC
15EI307	FLUID MECHANICS AND APPLIED THERMODYNAMICS LABORATORY	I,II,III	a,b,c,d,e,i,n	0	0	2	1	50	50	100	PC
15EI308	ELECTRON DEVICES AND CIRCUITS LABORATORY	I,II,III	a,b,c,d,m	0	0	2	1	50	50	100	PC
15EI309	MINI PROJECT I	I,II,III	a,b,c,d,e,f,g, h,i,j,k,l,m,n	0	0	2	1	100	-	100	EEC
15GE310	LIFE SKILLS: BUSINESS ENGLISH$^{\Phi}$	-	j	0	0	2	-	100	-	100	EEC
			Total	**17**	**6**	**10**	**24**	**600**	**400**	**1000**	**-**

FOURTH SEMESTER

Code No.	Course	Objectives & Outcomes: PEOs	Objectives & Outcomes: POs	L	T	P	C	Maximum Marks: CA	Maximum Marks: ES	Maximum Marks: Total	Category
15MA401	NUMERICAL METHODS AND STATISTICS$^{\beta}$	I,II,III	a	2	2	0	3	50	50	100	BS
15EI402	DATA STRUCTURES	I,II,III	a,b,c,	3	0	0	3	50	50	100	ES
15EI403	ELECTRICAL AND ELECTRONICS MEASUREMENTS	I,II,III	a,b,c,m	2	0	2	3	50	50	100	PC
15EI404	COMMUNICATION ENGINEERING	I,II,III	a,b,c,m	2	0	2	3	50	50	100	ES
15EI405	TRANSDUCERS ENGINEERING	I,II,III	a,b,c,m	3	0	0	3	50	50	100	PC
15EI406	LINEAR INTEGRATED CIRCUITS	I,II,III	a,b,c,d,m	3	2	0	4	50	50	100	PC
15EI407	SENSORS AND TRANSDUCERS LABORATORY	I,II,III	a,b,c,d,f,i,m	0	0	2	1	50	50	100	PC
15EI408	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	I,II,III	a,b,c,d,e,i,k,l ,m	0	0	2	1	50	50	100	PC
15EI409	MINI PROJECT II	I,II,III	a,b,c,d,e,f,g, h,i,j,k,l,m,n	0	0	2	1	100	-	100	EEC
15GE410	LIFE SKILLS: VERBAL ABILITY$^{\Phi}$	-	j	0	0	2	-	100	-	100	EEC
			Total	**15**	**4**	**12**	**22**	**600**	**400**	**1000**	**-**

$^{\alpha}$Common to all branches of B.E./B.Tech. except CSE
$^{\Phi}$Common to all branches of B.E./B.Tech (Non-Credit Course)
$^{\beta}$Common to AU,ME,MTRS,EEE,EIE,BT,TT,FT

FIFTH SEMESTER

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15EI501	CONTROL ENGINEERING	I,II,III	a,b,c,d,f,l,m,n	3	2	0	4	50	50	100	PC
15EI502	SMART AND WIRELESS INSTRUMENTATION	I,II,III	a,b,c,d,e,f,i,k,l,m	3	0	0	3	50	50	100	PC
15EI503	MICROPROCESSORS AND MICROCONTROLLERS	I,II,III	a,b,c,d,e,f,g,l,n	3	2	0	4	50	50	100	PC
15EI504	INDUSTRIAL INSTRUMENTATION I	I,II,III	a,b,c,d,e	3	0	0	3	50	50	100	PC
	ELECTIVE I	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE II	-	-	-	-	-	3	50	50	100	PE
15EI507	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	I,II,III	a,b,c,d,e	0	0	2	1	50	50	100	PC
15EI508	CONTROL ENGINEERING LABORATORY	I,II,III	a,b,c,d,e,l	0	0	2	1	50	50	100	PC
15EI509	TECHNICAL SEMINAR I	I,II,III	b,e,f,h,i,j,l	0	0	2	1	50	50	100	EEC
15EI510	MINI PROJECT III	I,II,III	a,b,c,d,e,f,g,h,i,j,k,l,m,n	0	0	2	1	100	-	100	EEC
15GE511	LIFE SKILLS: APTITUDE I$^{\Phi}$	-	a,b,f,g	0	0	2	-	100	-	100	EEC
			Total	**12**	**4**	**10**	**24**	**650**	**450**	**1100**	**-**

SIXTH SEMESTER

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			
		PEOs	POs					CA	ES	Total	Category
15GE701	ENGINEERING ECONOMICS$^{\$}$	I,II,III	f,g,j,k,l	3	0	0	3	50	50	100	HSS
15EI602	PROCESS CONTROL	I,II,III	a,b,c,d,n	3	2	0	4	50	50	100	PC
15EI603	INDUSTRIAL INSTRUMENTATION II	I,II,III	a,b,c,f,g,h,l,m,n	3	0	0	3	50	50	100	PC
15EI604	DIGITAL SIGNAL PROCESSING	I,II,III	a,b,c,d,e,l,n	3	2	0	4	50	50	100	PC
	ELECTIVE III	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IV	-	-	-	-	-	3	50	50	100	PE
15EI607	PROCESS CONTROL LABORATORY	I,II,III	a,b,c,d,e,i,m,n	0	0	2	1	50	50	100	PC
15EI608	INDUSTRIAL INSTRUMENTATION LABORATORY	I,II,III	a,b,c,d,i,m,n	0	0	2	1	50	50	100	PC
15EI609	TECHNICAL SEMINAR II	I,II,III	b,e,f,h,i,j,l	0	0	2	1	50	50	100	EEC
15EI610	MINI PROJECT IV	I,II,III	a,b,c,d,e,f,g,h,i,j,k,l,m,n	0	0	2	1	100	-	100	EEC
15GE611	LIFE SKILLS: APTITUDE II$^{\Phi}$	I,II,III	a,b,f,g	0	0	2	-	100	-	100	EEC
			Total	**12**	**4**	**10**	**24**	**650**	**450**	**1100**	**-**

$^{\Phi}$Common to all branches of B.E./B.Tech (Non-Credit Course)
$^{\$}$ Common to Common to CSE,ECE,EEE,EIE,IT (VI Semester) and to AE, AG,AU,CE,ME,MTRS,BT,FT,TT (VII Semester)

SEVENTH SEMESTER												
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	Maximum Marks			
		PEOs	**POs**					**CA**	**ES**	**Total**	**Category**
15GE601	PROFESSIONAL ETHICS[+]	-	h,k	2	0	0	2	50	50	100	HSS
15EI702	ANALYTICAL INSTRUMENTS	I,II,III	a,b,c,d,e,m,n	3	0	0	3	50	50	100	PC
15EI703	INDUSTRIAL AUTOMATION	I,II,III	a,b,c,d,e	3	2	0	4	50	50	100	PC
15EI704	BIOMEDICAL INSTRUMENTATION	I,II,III	a,b,c,d,e,f,g,h,l	3	0	0	3	50	50	100	PC
	ELECTIVE V	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VI	-	-	-	-	-	3	50	50	100	PE
15EI707	INDUSTRIAL AUTOMATION LABORATORY	I,II,III	a,b,c,e,i,n	0	0	2	1	50	50	100	PC
15EI708	DESIGN LABORATORY	I,II,III	a,b,c,d,e,f,g,h,i,m,n	0	0	2	1	50	50	100	PC
15EI709	MINI PROJECT V	I,II,III	a,b,c,d,e,f,g,h,i,j,k,l,m,n	0	0	2	1	100	-	100	EEC
15GE710	LIFE SKILLS : COMPETITIVE EXAMS[Φ]	I,II,III	a,b,l	0	0	2	-	100	-	100	EEC
			Total	**11**	**2**	**8**	**21**	**600**	**400**	**1000**	**-**

EIGHT SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	Maximum Marks			
		PEOs	**POs**					**CA**	**ES**	**Total**	**Category**
	ELECTIVE VII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VIII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IX	-	-	-	-	-	3	50	50	100	PE
15EI804	PROJECT WORK	I,II,III	a,b,c,d,e,f,g,h,i,j,k,l,m,n	-	-	-	9	50	50	100	EEC
			Total	-	-	-	**18**	**200**	**200**	**400**	**-**

[+] Common to Common to AE, AG,AU, CE, ME,MTRS,BT,FT,TT (VI Semester) and to CSE,ECE,EEE,EIE,IT (VII Semester)

[Φ]Common to all branches of B.E./B.Tech (Non-Credit Course)

Electives							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
LANGUAGE ELECTIVES							
15LE101	BASIC ENGLISH I	I,II,III	j	3	0	0	3
15LE102	COMMUNICATIVE ENGLISH I	I,II,III	j	3	0	0	3
15LE201	BASIC ENGLISH II	I,II,III	j	3	0	0	3
15LE202	COMMUNICATIVE ENGLISH II	I,II,III	j	3	0	0	3
15LC203	CHINESE	I,II,III	j	3	0	0	3
15LF203	FRENCH	I,II,III	j	3	0	0	3
15LG203	GERMAN	I,II,III	j	3	0	0	3
15LH203	HINDI	I,II,III	j	3	0	0	3
15LJ203	JAPANESE	I,II,III	j	3	0	0	3
PHYSICS ELECTIVES							
15PH201	PHYSICS OF MATERIALS	I,II,III	a,b,d	3	0	2	4
15PH202	APPLIED PHYSICS	I,II,III	a,b,d	3	0	2	4
15PH203	MATERIALS SCIENCE	I,II,III	a,b	3	0	2	4
15PH204	PHYSICS OF ENGINEERING MATERIALS	I,II,III	a,b,c	3	0	2	4
15PH205	SOLID STATE PHYSICS	I,II,III	a,b	3	0	2	4
CHEMISTRY ELECTIVES							
15CH201	ENGINEERING CHEMISTRY	I,II,III	a,b,d	3	0	2	4
15CH202	APPLIED CHEMISTRY	I,II,III	a,b,d	3	0	2	4
15CH203	APPLIED ELECTROCHEMISTRY	I,II,III	a,b	3	0	2	4
15CH204	INDUSTRIAL CHEMISTRY	I,II,III	a,b,c	3	0	2	4
15CH205	WATER TECHNOLOGY AND GREEN CHEMISTRY	I,II,III	a,b	3	0	2	4
DISCIPLINE ELECTIVES							
15EI001	MICROCONTROLLER BASED SYSTEM DESIGN	I,II,III	a,b,c,d,e,f,l,m,n	3	0	0	3
15EI002	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	I,II,III	a,b,c,d,e	3	0	0	3
15EI003	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	I,II,III	a,b,c,n	3	0	0	3
15EI004	ADVANCED PROCESS CONTROL	I,II,III	a,b,c,d,e,h,m,n	3	0	0	3
15EI005	POWER PLANT INSTRUMENTATION	I,II,III	a,b,c,d,m	3	0	0	3
15EI006	INDUSTRIAL ROBOTICS	I,II,III	a,c,d,n	3	0	0	3
15EI007	SOFT COMPUTING TECHNIQUES	I,II,III	a,b,c,d,e,k,n	3	0	0	3
15EI008	EMBEDDED SYSTEM	I,II,III	a,b,c,d,e,f,m,n	3	0	0	3
15EI009	CODES AND STANDARDS	I,II,III	a,b,c,d,f,h,m,n	3	0	0	3
15EI010	HYDRAULICS AND PNEUMATICS	I,II,III	a,b,c,d,n	3	0	0	3
15EI011	INSTRUMENTATION AND CONTROL IN IRON AND STEEL INDUSTRIES	I,II,III	a,b,c,d,e,g,h,j,k,m,n	3	0	0	3
15EI012	POWER ELECTRONICS AND DRIVES	I,II,III	a,c,e,l	3	0	0	3
15EI013	ELECTROMAGNETIC THEORY	I,II,III	a,b,c,d,f,g,i,j,l,m,n	3	0	0	3
15EI014	DIGITAL CONTROL SYSTEM	I,II,III	a,c,d,l	3	0	0	3
15EI015	DATA COMMUNICATION AND NETWORKS	I,II,III	a,b,c,d,n	3	0	0	3
15EI016	NEURAL NETWORKS AND FUZZY LOGIC	I,II,III	a,b,c,d,e	3	0	0	3
15EI017	INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES	I,II,III	a,b,c,d,e	3	0	0	3
15EI018	MICRO ELECTRO MECHANICAL SYSTEM	I,II,III	a,b,c,d,f,m	3	0	0	3
15EI019	INSTRUMENTATION IN AGRICULTURE	I,II,III	a,b,c,d,e,f,g,l,m,n	3	0	0	3
15EI020	TOTAL QUALITY MANAGEMENT	I,II,III	a,c,d,h,i,k,l	3	0	0	3

15EI021	INSTRUMENTATION IN FOOD PROCESSING INDUSTRIES	I,II,III	a,b,m,n	3	0	0	3
15EI022	JAVA PROGRAMMING	I,II,III	a,b,c,e,l	3	0	0	3
15EI023	FAULT DETECTION AND DIAGNOSIS	I,II,III	a,b,c	3	0	0	3
15EI024	INSTRUMENTATION SYSTEM DESIGN	I,II,III	a,b,c,k,m,n	3	0	0	3
15EI025	BUILDING AUTOMATION	I,II,III	a,b,c,d,g,i,l,m,n	3	0	0	3
15EI026	FIELD INSTRUMENTS AND PROCESS AUTOMATION	I,II,III	a,b,c,d,e,f,g,h,i,j,k,m,n	3	0	0	3
15EI027	INTERNET OF THINGS	I,II,III	a,b,c,d,e,f,m,n	3	0	0	3
15EI028	CHEMICAL PROCESS SYSTEMS	I,II,III	a,b,c,d,k,l,m,n	3	0	0	3
15EI029	AIRCRAFT INSTRUMENTATION	I,II,III	a,b,c,d,m,n	3	0	0	3
15EI030	OPTIMAL STATE ESTIMATION	I,II,III	a,b,c,d,e,i,k,m,n	3	0	0	3
ENTREPRENEURSHIP ELECTIVES							
15GE001	ENTREPRENEURSHIP DEVELOPMENT I	I,II,III	j	3	0	0	3
15GE002	ENTREPRENEURSHIP DEVELOPMENT II	I,II,III	j	3	0	0	3
PHYSICAL SCIENCE ELECTIVES							
15GE0P1	NANOMATERIALS SCIENCE	I,II,III	a,b,d	3	0	0	3
15GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	I,II,III	a,b,d	3	0	0	3
15GE0P3	APPLIED LASER SCIENCE	I,II,III	a,b	3	0	0	3
15GE0C1	CORROSION SCIENCE	I,II,III	a,b,c	3	0	0	3
15GE0C2	ENERGY STORING DEVICES AND FUEL CELLS	I,II,III	a,b	3	0	0	3
15GE0C3	POLYMER CHEMISTRY AND PROCESSING	I,II,III	a,b,d	3	0	0	3
OPEN ELECTIVES							
15EI0YA	BIO-MEDICAL INSTRUMENTATION	I,II,III	a,b,c,d,e,f,m,n	3	0	0	3
15EI0YB	VIRTUAL INSTRUMENTATION	I,II,III	a,b,c,d,e,m,n	3	0	0	3
15EI0YC	INSTRUMENTATION IN AEROSPACE AND NAVIGATION	I,II,III	a,b,c,d,e,m,n	3	0	0	3
15EI0YD	OPTOELECTRONICS AND LASER INSTRUMENTATION	I,II,III	a,b,c,d,e	3	0	0	3
15EI0YE	PROGRAMMABLE LOGIC CONTROLLERS	I,II,III	a,b,d,e,g,m,n	3	0	0	3
15EI0YF	SENSOR TECHNOLOGY	I,II,III	a,b,c,d	3	0	0	3
15EI0YG	INDUSTRIAL PROCESS AUTOMATION	I,II,III	a,b,c,d,e	3	0	0	3
ONE CREDIT COURSES							
15EI0XA	INDUSTRIAL SAFETY STANDARDS FOR INSTRUMENTATION PRODUCTS	I,II,III	a,b,c,f,g,h,n	1	0	0	1
15EI0XB	EMBEDDED SYSTEM DEVELOPMENT USING PIC MICROCONTROLLERS	I,II,III	a,b,c,e,f	1	0	0	1
15EI0XC	DETAILED INSTRUMENTATION ENGINEERING	I,II,III	a,b,c,e,f	1	0	0	1
15EI0XD	EMBEDDED SYSTEMS IN INSTRUMENTATION AND CONTROL	I,II,III	a,b,c,e,n	1	0	0	1
15EI0XE	ENERGY MANAGEMENT SYSTEMS IN INDUSTRIES	I,II,III	a,b,c,e,f,h	1	0	0	1
15EI0XF	DESIGN OF LOW COST AUTOMATION FOR INDUSTRIES	I,II,III	a,b,c,e,f,g,n	1	0	0	1
15EI0XG	MODELING AND ANALYSIS OF INSTRUMENTATION	I,II,III	a,b,c,e,g,n	1	0	0	1
15EI0XH	DESIGN OF LINEAR WEIGHING MACHINE	I,II,III	a,b,c,e,f,g,h	1	0	0	1
15EI0XI	HIGH TEMPERATURE INSTRUMENTATION	I,II,III	a,b,c,g,m,n	1	0	0	1
15EI0XJ	CALIBRATION TECHNIQUES	I,II,III	a,b,c,g,n	1	0	0	1
15EI0XK	HOOK-UP DIAGRAM	I,II,III	a,b,c,g,n	1	0	0	1
15EI0XL	INTERNET OF THINGS (IOT) WITH SENSOR DATA ACQUISITION IN CLOUD	I,II,III	a,b,c,e,g,n	1	0	0	1
15EI0XM	VFD BASED INDUSTRIAL APPLICATIONS	I,II,III	a,b,c,l	1	0	0	1
15EI0XN	IoT USING RASPBERRY PI	I,II,III	a,b,c	1	0	0	1
15EI0XO	DESIGN OF POWDER FILLING MACHINE	I,II,III	a,b,c,g,n	1	0	0	1
15EI0XP	IoT USING PYTHON	I,II,III	a,d,e,k,m,n	0	0	0	1
15EI0XQ	PRODOK SOFTWARE	I,II,III	a,b,e	1	0	0	1

15EI0XR	VIRTUAL INSTRUMENTATION IN INDUSTRIAL AUTOMATION	I,II,III	a,b,e	1	0	0	1
15EI0XS	PLC PROGRAMMING	I,II,III	a,b,e	1	0	0	1
15EI0XT	PIPING AND INSTRUMENTATION	I,II,III	a,b,e	1	0	0	1
ADDITIONAL ONE CREDIT COURSE							
15GE0XA	HEALTH AND FITNESS	-	-	1	0	0	1
15GE0XB	FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY	-	-	1	0	0	1
15GE0XC	VEDIC MATHEMATICS	-	-	1	0	0	1
15GE0XD	INTRODUCTION TO ALGORITHMS	-	-	1	0	0	1
15GE0XE	ETYMOLOGY	-	-	1	0	0	1
15GE0XF	HINDUSTANI MUSIC	-	-	1	0	0	1
15GE0XG	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	1	0	0	1
15GE0XH	AGRICULTURE FOR ENGINEERS	-	-	1	0	0	1
15GE0XI	INTRODUCTION TO DATA ANALYSIS USING SOFTWARE	-	-	1	0	0	1
15GE0XJ	ANALYSIS USING PIVOT TABLE	-	-	1	0	0	1
15GE0XK	INTERVIEW SKILLS	-	-	1	0	0	1
15GE0XL	JOURNALISM AND MASS COMMUNICATION	-	-	1	0	0	1
15GE0XM	VISUAL MEDIA AND FILM MAKING	-	-	1	0	0	1
15GE0XN	YOGA FOR HUMAN EXCELLENCE	-	-	1	0	0	1
15GE0XO	CARNATIC MUSIC	-	-	1	0	0	1
15GE0XP	GENERAL PSYCOLOGY	-	-	1	0	0	1
15GE0XQ	NEURO BEHAVIOURAL SCIENCE	-	-	1	0	0	1
15GE0XR	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	1	0	0	1
15GE0XS	DISRUPTIVE INNOVATION BASED START UP ACTIVITIES	-	-	1	0	0	1
15GE0XT	VISION INDIA	-	-	1	0	0	1
15GE0XU	HEALTH AND FITNESS	-	-	1	0	0	1
15GE0XV	FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY	-	-	1	0	0	1
15GE0XW	VEDIC MATHEMATICS	-	-	1	0	0	1
15GE0XX	INTRODUCTION TO ALGORITHMS	-	-	1	0	0	1
VALUE ADDED COURSES							
15EIV01	LABVIEW PROGRAMMING FOR PROCESS CONTROL						
15EIV02	MATLAB PROGRAMMING FOR CONTROL ENGINEERING						
15EIV03	C PROGRAMMING FOR INSTRUMENTATION						
BRIDGE COURSES							
15EIB01	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING						
15EIB02	ELECTRIC CIRCUIT ANALYSIS						

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	7	12	4	3	-	-	-	-	26	15%	15%	20%
2	ES	9	7	7	6	-	-	-	-	29	16%	15%	20%
3	HSS	6	3	-	-	-	3	2	-	14	8%	5%	10%
4	PC	-	-	12	12	16	13	12	-	65	37%	30%	40%
5	PE	-	-			6	6	6	9	27	15%	10%	15%
6	EEC	-	-	1	1	2	2	1	9	16	9%	10%	15%
Total		22	22	24	22	24	24	21	18	177	100%	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

15MA101 MATRICES AND CALCULUS 3 2 0 4

Course Objectives

- Interpret the introductory concepts of Matrices and Calculus, which will enable them to model and analyze physical phenomena involving continuous changes of variables
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Matrices and Calculus.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyze the characteristics of a linear system with eigen values and vectors.
2. Identify and model the real time problem using first order linear differential equations.
3. Recognize and solve the higher order ordinary differential equations.
4. Characterize the functions and get the solutions of the same.
5. Evaluate the functions to get the surface area and volume using multiple integral.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	1	2												
3	1													
4	1	2												
5	3													

UNIT I **9 Hours**

MATRICES

Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values-Stretching of elastic membranes. Cayley - Hamilton Theorem - Quadratic form: Reduction of a quadratic form to a canonical form.

UNIT II **8 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER

Leibnitz's Equations - Modelling and solutions using Newtons law of cooling of bodies - solutions to R-L and R-C electric circuits.

UNIT III **11 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

Linear differential equations of second and higher order with constant coefficients. Linear differential equations of higher order with variable coefficients: Cauchys linear differential equation - Method of variation of parameters for second order differential equations.

UNIT IV **9 Hours**

MULTIVARIABLE CALCULUS

Functions of Two Variables and their solutions- Total Differential - Derivative of implicit functions-Jacobians Unconstrained maxima and minima.

UNIT V **8 Hours**

MULTIPLE INTEGRALS

Double integration with constant and variable limits-Region of integration -Change the order of integration -Area as double integral in cartesian coordinates. Triple integral in Cartesian coordinates.

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order

Total: 75 Hours

Reference(s)

1. C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015.
3. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
4. B.S. Grewal, Higher Engineering Mathematics, Forty Third Edition, Khanna Publications , New Delhi 2014.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.
6. T.Veerarajan, Engineering mathematics for First Year,Tata McGraw-Hill Publishing company Limited, New Delhi, 2014.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6					6			6											20
2	2					2				4					4				6						18
3		2			2						6			6					6						22
4		2					6				8				6										22
5	2						4			6									6						18
																								Total	100

Assessment Questions

Remember

1. Define spectral values of a matrix.
2. State Cayley - Hamilton theorem.

3. List out five natures of a quadratic form.
4. Reproduce the solution for the first order linear differential equation $\frac{dy}{dx}+Py=Q$
5. State Newton's Law of cooling in ordinary differential equation.
6. Define Jacobian in three dimensions
7. State Wronskian determinant.
8. List two sufficient conditions for extremum of a function $z=f(x,y)\ at\ \ (a,b)$.
9. Define Jacobian of $u\ \ and\ \ v$ with respect to $x\ \ and\ \ y$.
10. Recall any two properties of Jacobians.

Understand

1. Identify whether there exist a square matrix without eigenvalues. Give reason.
2. Indicate the matrix which has real eigenvalues and real eigenvectors.
3. Identify in which cases can we expect orthogonal eigen vectors.
4. Compare second and higher order ordinary differential equation.
5. A condenser of capacity C discharged through an inductance L and resistance R in series and the charge q at the time t satisfies the equation L$\frac{d^2q}{dt^2}$+R$\frac{dq}{dt}+\frac{q}{c}$=0.given that L=0.25 Henries, R=250 ohms, C=2×10^{-6} Farads and that when t=0, charge q is 0.002 coulombs and the current $\frac{dq}{dt}$=0, obtain the value of q in terms of t.
6. Represent the area bounded by the parabolas y^2=4-x and y^2=4-4x as a double integral.
7. Formulate Leibnitz's equation where R=100 ohms L=0.05 henry E=100 Cos300t volts
8. A condenser of capacity C discharged through an inductance L and resistance R in series and the charge q at the time t satisfies the equation L$\frac{d^2q}{dt^2}$+R$\frac{dq}{dt}+\frac{q}{c}$=0.the circuit consists of an inductor of 1H, a resistor of 12Ω, capacitor of 0.01 F and a generator having voltage given by E(t)=24 sin10t.find the charge q and the current I at time t, if q=0 and i=0 at t=0 where i=$\frac{dq}{dt}$.
9. Formulate the area between the curves y^2=4x and x^2=4y.
10. Indicate and change the order of integration for $\int_0^1\int_{x^2}^{2-x} xydydx$

Apply

1. Carry-out the three engineering applications of eigen value of a matrix.
2. Find the eigen values and eigen vectors of the matrix A = $\begin{pmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{pmatrix}$ and hence find the eigen values of A^2, 5A and A^{-1} using properties.
3. Use Cayley Hamilton theorem to find inverse of A = $\begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$.
4. Find the points of the function $f(x,y)=x^2y+xy^2-axy$ where f is a maximum or minimum.
5. A body originally at 80^{0}C cools down to 60^{0}C in 20 minutes, the temperature of the air being

40^0C. What will be the temperature of the body after 40 minutes from the original?

6. If the temperature of a cake is 300^0F when it leaves the oven and is 200^0F 10 minutes later, when will it be practically equal to the room temperature of 60^0F, say, when will it be 61^0F? Use Newton's law of cooling.
7. In an L-C-R circuit, the change q on a plate of a condenser is given by $L\frac{d^2q}{dt^2} + R\frac{dq}{dt}\frac{q}{c}$ =Esinpt,wherei= $\frac{dq}{dt}$ .the circuit is tuned to resonance so that $p^2=1/LC$. If initially the current I and the charge q be zero. Show that ,for small values of R/L, the current in the circuit at time t is given by (Et/2L)sinpt.
8. Construct the solution for the equation $(D^3 - D)y = xe^x$
9. Use the method of variation of parameters to solve $(D^2+4)y = \cot 2x$.
10. Construct the equation $x^2y'' + xy' = x$ into a linear differential equation with constant Coefficient.

Analyze

1. Justify whether the matrix B = $\begin{pmatrix} \cos^- & \sin^- & 0 \\ -\sin^- & \cos^- & 0 \\ 0 & 0 & 1 \end{pmatrix}$ is orthogonal or not?
2. Suppose that in winter the day time temperature in a certain office building is maintained at 70°F, The heating is shut off at 10 P.M. and turned on again at 6 A.M. On a certain day the temperature inside the building at 2 A.M. was found to be 65°F. The outside temperature was 50°F at 10 P.M. and had dropped to 40°F by 6 A.M. Find the temperature inside the building when the heat was turned on at 6 A.M.?
3. Experiment show that the radioactive substance decomposes at a rate proportional to the amount Present. Starting with 2grms at time t=0 find the amount available at a later time.
4. Differentiate RL and RC electric circuit.
5. Transform the equation $x^2y'' + xy' = x$into a linear differential equation with constant coefficients.
6. If the voltage in the RC circuit is $E = E_0 \cos \omega t$, find the charge and the current at time t.
7. Solve $(x^2D^2-2xD+2)y = (3x^2-6x+6)e^x$, $y(1) = 2 + 3e$, $y'(1) = 3e$
8. In a circuit the resistance is 12Ω and the inductance is 4 H. The battery gives a constant voltage of 60 V and the switch is closed when t = 0, so the current starts with I(0) = 0. (a) Find I(t) (b) Find what happens to the current after a long time justify the current after 1 s.
9. If $g(x,y) = \cdot\ (u,v)$ where $u = x^2 - y^2,\ v = 2xy$ prove that

$$\frac{\partial^2 g}{\partial x^2} + \frac{\partial^2 g}{\partial y^2} = 4(x^2+y^2)\left(\frac{\partial^2 \cdot}{\partial u^2} + \frac{\partial^2 \cdot}{\partial v^2}\right).$$

10. Solve $\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-x^2-y^2}} xdxdydz$.

Evaluate

1. Use Cayley-Hamilton theorem to find the value of $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$ if the matrix A = $\begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$

2. Determine the nature, index, rank and signature by reducing the quadratic form $2x^2+2y^2+2z^2+2yz$ to canonical form by an orthogonal transformation.
3. Determine the value of y from the equation $\frac{dy}{dx} = \frac{x^2+y^2+1}{2xy}$
4. Determine the solution of y of the equation $\sqrt{1-y^2}dx = (sin^{-1}x - x)dy$.
5. Determine the value of y from the equation $\frac{dy}{dx} - \frac{tany}{1+x} = (1+x)e^x secy$.
6. Determine the complete solution for y from the equation $\frac{d^2y}{dx^2} + \frac{1}{x}\frac{dy}{dx} = \frac{12logx}{x^2}$.
7. Determine the complete solution for y of $(x^2D^2 - xD + 4)y = x^2 \sin(\log x)$.
8. Determine the solution of the initial value problem $y'' + y' - 6y = 0$ with the initial conditions y(0)=10 and $y'(0) = 0$.
9. Evaluate $\iiint (x^2 + y^2 + z^2)\, dxdydz$ taken over the region of space defined by $x^2 + y^2 \le 1$ and $0 \le x \le 1$.
10. Evaluate $\int_0^a \int_y^a \frac{x}{x^2 + y^2} dxdy$ by changing into polar coordinates

15PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- To impart knowledge in properties of matter, crystallography and ultrasonics
- To understand the applications of lasers and fiber optics
- To implement the principles of quantum physics in the respective engineering fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyze the concept of properties of matter and apply the same for practical applications
2. Identify the suitable laser source for fiber optic communication applications
3. Analyze the properties of ultrasonic waves and apply the same for day today applications
4. classify the different types of crystal structures and analyze their properties
5. Apply the Schrodinger wave equation to illustrate the motion of quantum particles

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	2	1												
4	1	1												
5	1	1												

UNIT I **8 Hours**

PROPERTIES OF MATTER

Elasticity: elastic and plastic materials - Hooke's law - elastic behavior of a material -stress -strain diagram- factors affecting elasticity. Three moduli of elasticity- Poisson's ratio-torsional pendulum-twisting couple on a cylinder. Young's modulus- uniform bending -non- uniform bending. Viscosity: coefficient of viscosity -streamline and turbulent flow -experimental determination of viscosity of a liquid -Poiseuille's method.

UNIT II **6 Hours**

APPLIED OPTICS

Interference: air wedge- theory- uses- testing of flat surfaces- thickness of a thin wire. Laser: introduction-principle of laser- characteristics of laser- types: CO2 laser -semiconductor laser (homo junction). Fiber optics: principle of light transmission through fiber- expression for acceptance angle and numerical aperture- types of optical fibers (refractive index profile and mode)- fiber optic communication system (block diagram only).

UNIT III **5 Hours**

ULTRASONICS

Ultrasonics: introduction- properties of ultrasonic waves-generation of ultrasonic waves-magnetostriction- piezo electric methods- detection of ultrasonic waves. Determination of velocity of ultrasonic waves (acoustic grating). Applications of ultrasonic waves: SONAR- measurement of velocity of blood flow -study of movement of internal organs.

UNIT IV **5 Hours**

SOLID STATE PHYSICS

Crystal Physics: lattice -unit cell -crystal systems- Bravais lattices- Miller indices- 'd' spacing in cubic lattice- calculation of number of atoms per unit cell, atomic radius, coordination number and packing density for SC, BCC, FCC and HCP structures- X-ray diffraction: Laue's method - powder crystal method.

UNIT V **6 Hours**

QUANTUM MECHANICS

Quantum Physics: development of quantum theory- de Broglie wavelength -Schrodinger's wave equation-time dependent and time independent wave equations- physical significance. Application: particle in a box (1d)- degenerate and non-degenerate states. Photoelectric effect: quantum theory of light work function- problems.

FOR FURTHER READING

Neutrions - expanding universe

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Determine the moment of inertia of the disc and calculate the rigidity modulus of a given wire using torsion pendulum (symmetrical masses method).

3 **4 Hours**

EXPERIMENT 2

Find the elevation of the given wooden beam at the midpoint by loading at the ends and hence calculate the Youngs modulus of the material.

4 **4 Hours**

EXPERIMENT 3

Find the depression at the midpoint of the given wooden beam for 50g, 100 g, 150 g, 200 g and 250 g subjected to non-uniform bending and determine the Youngs modulus of the material of the beam.

5 **4 Hours**

EXPERIMENT 4

Determine the coefficient of viscosity of the given liquid by Poiseulles method.

6 **4 Hours**

EXPERIMENT 5

Form the interference fringes from the air wedge setup and calculate the thickness of the given wire.

7 **4 Hours**

EXPERIMENT 6

By applying the principle of diffraction, determine the wavelength of given laser and the average particle size of lycopodium powder using laser source.

8 **4 Hours**

EXPERIMENT 7

Determine the
(i) wavelength of ultrasonics in a liquid medium,
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using ultrasonic interferometer.

Total: 60 Hours

Reference(s)

1. D. S. Mathur, Elements of Properties of Matter, 5th edition, S Chand & Company Ltd., New Delhi, 2012.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2012.
3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. B. K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
5. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
6. Ian Morison, Introduction to Astronomy and Cosmology, John Wiley and Sons, Ltd., 2013.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				4	2				6				4				4						24
2		2				2	6			2	4			4											20
3		4				4	2			4				4											18
4	2	2				4					5			5											18
5	2	2				4	4			4					4										20
																								Total	100

Assessment Questions

Remember

1. Reproduce Hooke’s law
2. Name the three types of moduli of elasticity
3. List the two applications of air wedge
4. Define magnetostriction effect
5. Recognize the four applications of ultrasonics in medical field
6. Write the Bragg’s condition necessary for obtaining X-ray diffraction in crystals
7. Retrieve the seven types of crystal system
8. Recall four physical significance of wave function
9. Define photoelectric effect

Understand

1. Explain the procedure adopted for determining the Young’s modulus of the given material by non-uniform bending method
2. Illustrate the effect of temperature on elasticity of a material
3. Classify the fiber optics based on refractive index profile
4. Indicate the role of optical resonators in the production of laser
5. Compare the merits of magnetostriction and piezo-electric oscillators
6. Summarize the four applications of ultrasonic waves in day-today life
7. Identify the closely packed cubic crystal structure with an example
8. Compare Laue method and powder crystal method used in X-ray diffraction
9. Infer the significance of photoelectric effect
10. Represent the two assumptions involved in solving the Schrödinger time dependent wave equation

Apply

1. Show that when a cylinder is twisted the torsional couple depends on torsional rigidity
2. Using torsional pendulum, explain the rigidity modulus of the wire
3. Design an experimental setup used for determining the thickness of a thin material
4. A silica optical fiber has a core refractive index of 1.50 and a cladding refractive index of 1.47. Find the numerical aperture for the fiber.
5. Construct the piezo electric oscillator circuit and explain the generation of ultrasonic waves
6. Find the depth of submerged submarine if an ultrasonic wave is received after 0.33 s from the time of transmission.(given v=1400 m/s)
7. Show that the axial ratio for an ideal HCP structure is 1.633
8. Sketch the planes having Miller indices (100) and (111).
9. Assess the various energy levels of an electron enclosed in a one dimensional potential well of finite width ‘a’
10. Compute the relation between de Broglie wavelength and velocity of a particle

Analyse

1. Differentiate uniform bending from non-uniform bending
2. Straight lined fringes are formed only in flat glass plates. Justify.
3. Conclude that the thickness of thin wire is influenced by band width of a material
4. Outline the merits and demerits of magnetostriction oscillator method.
5. Five fold symmetry is not possible in crystal structures. Justify your answer.
6. Compare the degenerate state with non-degenerate state

Evaluate

1. Determine the viscosity of a given liquid using Poiseuille's method (Given: water, burette, stop clock, capillary tube, stand and travelling microscope)
2. When ultrasonic waves are passed through liquids, cavitations are produced. Criticize the statement
3. Check the packing factor for a simple cubic structure is 0.52
4. Evaluate the expression for time dependent Schroedinger's wave equation

15CH103 ENVIRONMENTAL SCIENCE

2 0 2 3

Course Objectives

- Realize the interdisciplinary and holistic nature of the environment
- Understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development
- Recognize the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources.
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation.
3. Identify the existing environmental challenges related to pollution and its management.
4. Select suitable strategies for sustainable management of components of environmental.
5. Correlate the impacts of population and human activities on environment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2											
2		2												
3			3			3	1							
4			2			1	3							
5			2			2	2							

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification) - water logging - salinity - case studies. Energy resources: renewable(solar, wind, tidal, geothermal and hydroelectric power) - non renewable energy sources

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: forest ecosystem - desert ecosystem - ecological succession. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity - field study

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - marine pollution - thermal pollution - noise pollution. Disaster management: causes - effects - control measures of floods - earthquake - cyclone - landslides

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - urban problems related to energy. Environmental ethics - issues and possible solutions - solid waste management - causes - effects - 3R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. Environment protection act: Air (Prevention and control of pollution) act - wildlife protection act

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - women and child welfare programmes - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights:E - waste and biomedical waste -Identification of adulterants in food materials

1 **2 Hours**

EXPERIMENT 1

General instructions to students for handling the reagents and safety precautions.

2 **4 Hours**

EXPERIMENT 2

Estimation of dissolved oxygen in a water sample/sewage by Winklers method

3 **4 Hours**

EXPERIMENT 3

Estimation of chloride content in water by argentometric method

4 **4 Hours**

EXPERIMENT 4

Estimation of calcium in lime by complexometric method

5 **4 Hours**

EXPERIMENT 5

Estimation of chromium in leather tannery effluents

6 **4 Hours**

EXPERIMENT 6

Determination of percentage purity of washing soda

7 **4 Hours**

EXPERIMENT 7

Estimation of heavy metals in the given solution by EDTA method

8 **4 Hours**

EXPERIMENT 8

Determination of Prussian blue dye concentration by spectrophotometer

Total: 60 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. A. Ravikrishnan, Environmental Science and Engineering, 5th revised Edition, Sri Krishna Hitech Publishing company (P) Ltd, Chennai, 2010
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. E. Bharucha, Textbook of Environmental studies, second Edition, Universities Press Pvt. Ltd., New Delhi, 2013
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	2			4	5				1			1	3				1							20
2	4	1			4	7							1	2				1							20
3	3				4	6	2		1	1			1	1				1							20
4	1	2			3	8	1			4			2	4											25
5	1	2			2	5				1			1	3											15
																								Total	100

Assessment Questions

Remember

1. Define the term bio-magnification.
2. Name any four major gaseous responsible for air pollution.
3. Recall four gases responsible for greenhouse effect.
4. State environmental ethics.
5. List any two impacts of water pollution.
6. Mention the two objectives of value education.
7. List any four consequences of air pollution on human health.
8. Recall any two endangered and endemic species of India.
9. List any two disadvantages of nuclear energy production.

Understand

1. Summarize the structural and functional attributes of an ecosystem.
2. With the help of neat flow chart explain waste water treatment process using activated sludge process.
3. Explain the modern method of rain water harvesting technique diagrammatically and discuss the various strategies adopted for water conservation.
4. Summarize the abstracts of Wildlife (protection) Act, 1972.
5. Indicate the three consequences of noise pollution.
6. Classify the ecosystems on the basis of energy sources
7. Infer two types of photochemical reactions involved in formation and destruction of ozone in the stratosphere.
8. Explain how the impacts of natural disasters can be minimized on human communities with on representative example.
9. Summarize four major effects caused on forests and tribal people due to big dam construction.
10. Infer the any two conflicts over water, confining to our nation.
11. Identify three major threats to Indian biodiversity
12. Relate the concept of food chain and food web with tropic level and mention their three significances.

Apply

1. Identify any seven impacts caused if ground water is used enormously.
2. Select the proper disaster management techiques that can be implemented to manage. a) Earthquake b) Floods
3. Summarize the concept age-structure pyramids as a tool to achieve stabilized population in our nation.
4. Predict the significances of child welfare programmes in India.
5. Implement the 3R approach to manage solid waste.

6. Assess the four adverse effects of solid waste.
7. Assess how climate change affects human health.

Analyse

1. Differentiate between confined and unconfined aquifers.
2. Distinguish between critical and strategic minerals with two examples for each.
3. Outline variations in population growth among nations with necessary diagram.
4. “Day by day our atmosphere gets prone to serious effects” and “deterioration of environment affects human health”. Justify these two statements.
5. Compare the major two advantages and limitations of major greenhouse pollutant CO2.

Evaluate

1. Choose any one suitable method to minimize the impact of acid rain on environment.
2. Determine the doubling time of population, if annual growth rate of a nation is 25 years.

15GE205 BASICS OF CIVIL AND MECHANICAL ENGINEERING **3 0 0 3**

Course Objectives

- To impart basic knowledge in the field of Civil Engineering
- To guide students to select the good building materials
- To create awareness on various types of water supply and transportation systems
- To impart basic knowledge in the various engineering materials and manufacturing Processes.
- To understand the working principles of various Internal Combustion Engines, Refrigeration, Boiler and power plants.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Illustrate the concepts and fundamental philosophies of Civil Engineering.
2. Classify the components of building with its functions and material qualities.
3. Explain the sources of water supply and transportation systems.
4. Identify various engineering materials and manufacturing processes.
5. Classify the working principles and operations of Internal Combustion Engines and Refrigeration cycles.
6. Identify different Energy sources and classify types of boilers, turbine and power plants.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	3													
3	3						2							
4	3						2							
5	3													
6	3						2							

UNIT I **7 Hours**

INTRODUCTION TO CIVIL ENGINEERING

History, development and scope of Civil Engineering Functions of Civil Engineers.Construction Materials Characteristics of good building materials such as Stones Bricks -Cement - Aggregates and concrete. Surveying: Definition and purpose Classification Basic principles Measurement of length by chains and tapes.

UNIT II **7 Hours**

GENERAL FEATURES RELATING TO BUILDINGS

Selection of site Basic functions of buildings Major components of buildings. Types of foundation Bearing capacity of soils General Principles of Brick masonry Stone masonry Beams Lintels Columns Doors and windows Introduction to Green Building and Interior Design

UNIT III **7 Hours**

WATER SUPPLY AND TRANSPORTATION SYSTEMS

Sources of water Supply Methods of Rain Water Harvesting Flow Diagram of Water treatment Process Modes of Transportation Systems. Classification of Highways-Components of roads Bituminous and cement concrete roads. Importance of railways - Gauges Components of permanent way Types of bridges.

UNIT IV **8 Hours**

ENGINEERING MATERIALS AND MANUFACTURING PROCESSES

Materials classification, mechanical properties of cast iron, steel and high speed steel Casting process-Introduction to green sand moulding, pattern, melting furnace electric furnace Introduction to metal forming process and types Introduction to arc and gas welding Centre lathe, Drilling and Milling machines principal parts, operations.

UNIT V **8 Hours**

INTERNAL COMBUSTION ENGINES AND REFRIGERATION

Internal Combustion (IC) Classification, main components, working principle of a two and four stroke petrol and diesel engines, differences Refrigeration working principle of vapour compression and absorption system Introduction to Air conditioning.

UNIT VI **8 Hours**

ENERGY, BOILERS, TURBINE AND POWER PLANTS

Energy-Solar,Wind,Tidal,Geothermal,Biomass and Ocean Thermal Energy Conversion (OTEC)Boilers classification, Babcock and Wilcox and La-Mont Boilers, differences between fire tube and water tube boiler Steam turbines- working principle of single stage impulse and reaction turbines Power plant classification, Steam, Hydel, Diesel, and Nuclear power plants.

Total: 45 Hours

Reference(s)

1. N. Arunachalam, Bascis of Civil Engineering, Pratheeba Publishers, 2000
2. M. S. Palanichamy, Basic Civil Engineering, TMH, 2009
3. G. Shanmugamand M. S. Palanichamy, Basic Civil and Mechanical Engineering,Tata McGraw Hill Publishing Co., New Delhi, 2009
4. Pravin Kumar, Basic Mechanical Engineering, Pearson Education India, Pearson,2013.
5. G. Shanmugam and S. Ravindran, Basic Mechanical Engineering, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2013.
6. S. R. J. Shantha Kumar, Basic Mechanical Engineering, Hi-tech Publications, Mayiladuthurai, 2015

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	7					10																			17
2	7					10																			17
3	4					6			4																14
4	7					12																			19
5	5					10																			15
6	6					12																			18
																								Total	100

Assessment Questions

Remember

1. Classify Boiler.
2. What are the uses of high carbon steel?
3. Define welding
4. Define soldering.
5. Define Brazing.
6. What do you mean by milling?
7. Classify IC Engines.
8. List the various components of IC Engines.
9. Define Refrigeration.
10. Classify Boiler.
11. What is turbine?
12. Define water tube boiler.
13. Name the main parts of a turbine.
14. Classify power plants.
15. Writedown the scope of Civil Engineering.
16. Define surveying.
17. List the ingredients of concrete.
18. State the basic principles of survey.
19. What is meant by lintel?
20. Write down the components of buildings.
21. List the functions of foundation.
22. What is meant by bearing capacity of soil?
23. What are the factors to be considered in selection of site?

24. Define gauges.
25. Name the components of permanent way.
26. State the importance of railway.
27. List out the types of bridge.
28. Write down the classification of highway.
29. What do you meant by rain water harvesting
30. What are the factors to be considered in design of green building?

Understand

1. Compare reaction and impulse turbines.
2. What is the difference between renewable and non-renewable sources of energy?
3. What is the function of a hydraulic turbine?
4. What is the function of a surge tank in Hydel power plant?
5. What is the function of a moderator in Nuclear power plant?
6. How to select the boiler?
7. Why air is pre-heated before enter into boiler?
8. How does a fusible plug function in boiler?
9. What is the function of a spark plug in IC engine?
10. What is the function of a fuel injector in diesel engine?
11. Compare and contrast 4 stroke and 2 stroke engine.
12. Describe the characteristics of good building stone.
13. Explain the various functions of Civil Engineer.
14. Discuss in detail about principles of surveying.
15. Describe the characteristics of cement and concrete.
16. Differentiate the English and Flemish bonds brick masonry.
17. What are the points to be observed in the construction of brick masonry?
18. Discuss about any four super structure components.
19. Distinguish between shallow and deep foundation.
20. Distinguish between stone and brick masonry.
21. Differentiate bituminous and cement concrete roads.
22. Elucidate the components of permanent way.
23. Describe the cross section of bituminous pavement.
24. Elucidate different sources of water supply.

Apply

1. Explain in detail about rain water harvesting.
2. Explain the process of water treatment.
3. Enumerate the procedure for construction of water bound macadam road.

15GE106 C PROGRAMMING 3 0 2 4

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Implement C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing C programs.
3. Develop C programs using the concepts of Arrays and strings.
4. Apply the concepts of functions and pointers in writing C programs.
5. Design applications using structures, unions and files in C.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3			3									
2	2	3			3									
3	2	3			3									
4	1	3			3									
5	1	3			3									

9 Hours

UNIT I

INTRODUCTORY CONCEPTS

C Primitives: Introduction to C- Planning and writing a C program- Character Set - Keywords and Identifiers - Data Types - Variables and Constants - Compiling and executing the C program Operators and Expressions: Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator - Precedence and order of evaluation - Type Conversion Input and Output Operations: Formatted I/O functions - getchar and putchar function - gets and puts functions

UNIT II **7 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement - if else statement - nesting of if else Statement - Switch Statement. Decision Making and Looping: while statement - do while statement - for statement - Nested for statement Jump Statements: goto - break - continue - return statement

UNIT III **9 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays, multi dimensional arrays.
Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNIT IV **10 Hours**

FUNCTIONS AND POINTERS

User Defined Functions: Elements of user defined functions - Definition of functions - return values and their types - function calls - function declaration - categories of function - call by value and call by reference - recursion - Pre-processor directives and macros.
Pointers: Understanding Pointers - accessing the address of the variable - declaring pointer variables - Initialization of pointer variables - Accessing a variable through its pointer

UNIT V **10 Hours**

STRUCTURES AND FILES

Storage Class Specifiers: Auto - registers - static - extern - typedef
Structures and Unions: Introduction - defining a structure - declaring structure variables - accessing structure members - structure initialization - Unions - Enumerated data type
File Management in C: Defining and opening a file - closing a file - Input/output operations on files - Command line arguments

FOR FURTHER READING

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.
Creating and manipulating document using word - Mail merge - Creating spread sheet with charts and formula using excel - developing power point presentation with Animations.

1 **3 Hours**

EXPERIMENT 1

Write a C program to perform arithmetic operations on integers and floating point numbers.

2 **3 Hours**

EXPERIMENT 2

Write a C program to implement ternary operator and relational operators.

3 **3 Hours**

EXPERIMENT 3

Write a C program to read the values of A,B,C through the keyboard. Add them and after addition check if it is in the range of 100 to 200 or not. Print separate message for each.

4 **3 Hours**

EXPERIMENT 4

Write a C program to display the roots of a quadratic equation with their types using switch case.

5 **3 Hours**

EXPERIMENT 5

Write a C program to generate the following triangle.

1
1 2 3
1 2 3 4 5
1 2 3 4 5 6 7

6 **3 Hours**

EXPERIMENT 6

Write a C program to get a matrix of order 3x3 and display a matrix of order of 4x4, with the fourth row and column as the sum of rows and columns respectively.

7 **3 Hours**

EXPERIMENT 7

Write a C program to remove the occurrence of "the" word from entered string.

8 **3 Hours**

EXPERIMENT 8

Write a C program to find the factorial of given number.

9 **3 Hours**

EXPERIMENT 9

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

details: rollno, name, branch, year, section, cgpa.

****
NAME:
ROLL NO:
BRANCH:
YEAR:
SECTION:
CGPA:

10 **3 Hours**

EXPERIMENT 10

Create two files test1.txt and test2.txt and write a C program to read the file text1.txt character by character on the screen and paste it at the end of test2.txt.

Total: 75 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	2				2	4				6				2				2				2			20
3	2				2					6				2	3							6			21
4		2			2					6				2	3							6			21
5		2				2				6				6								6			22
																								Total	100

Assessment Questions
Remember

1. List the rules for defining a variable.
2. State the associativity property of an operator.
3. List the three constructs for performing loop operations.
4. Recall return statement.
5. Define an array.
6. Recognize strings.
7. Define functions.
8. Define pointers.
9. Define a structure.
10. List the functions used for opening and closing a file.

Understand

1. Classify the operators in C.
2. Identify the functions used for formatted I/O in C.
3. Summarize the branching statements in C.
4. Summarize the looping statements in C.
5. Classify the types of arrays in C.
6. Summarize the string handling functions in C.
7. Exemplify call by value and call by reference.
8. Illustrate the pointer concepts in C.
9. Summarize the four storage classes.
10. Explain the concept of files in C.

Apply

1. Compute the greatest of two numbers using ternary operators in C.
2. Demonstrate the concept of type conversion in C.
3. Implement a C program to find the roots of a quadratic equation using Switch case statement.

4. Implement a C program to check whether a number is prime or not.
5. Compute matrix multiplication using two dimensional arrays in C.
6. Execute a C program to check whether a string is a palindrome or not.
7. Implement a C program using functions to find factorial of a number.
8. Implement a C program to use pointers in C.
9. Execute a C program to generate a pay slip for an employee using structures.
10. Implement a C program to copy the content of one file to the other.

Analyse

1. Differentiate getchar and putchar functions.
2. Differentiate while and do while loop in C.
3. Compare strupr and strlwr functions.
4. Differentiate function definition and function call.
5. Compare structure and union.

Evaluate

1. Determine the output of the following code.
```
#include
int main()
{
int var = 010;
printf("%d", var);
}
```
2. Determine the value of the logical expression a>b && a
3. Determine the output of the C code
```
#include
int main()
{
int a[5] = {5, 1, 15, 20, 25};
int i, j, m;
i = ++a[1];
j = a[1]++;
m = a[i++];
printf("%d, %d, %d", i, j, m);
return 0;
}
```

4. Determine the output of this C code.
```
#include
int main()
{
int a = 10, b = 10;
if (a = 5)
b--;
printf("%d, %d", a, b--);
}
```

5. Evaluate the expression c=(a+b*(c/d)%e) with a=10, b=3, c=5, d=6 and e=1

Create

1. Generate a structure to store the following details: Rollno, Name, Mark1, Mark2, Mark3, Total, Average, Result and Class. Write a program to read Rollno, name and 3 subject marks. Find out the total, result and class as follows:
   a) Total is the addition of 3 subject marks.
   b) Result is "Pass" if all subject marks are greater than or equal to 50 else "Fail".
   c) Class will be awarded for students who have cleared 3 subjects
   i. Class "Distinction" if average >=75 ii. Class "First" if average lies between 60 to 74 (both inclusive) iii. Class "Second" if average lies between 50 & 59 (both inclusive)
   d) Repeat the above program to manipulate 10 students' details and sort the structures as per rank obtained by them.
2. Create a structure that can describe the employees with the fields Eno, Ename. Basic. Write a program to calculate DA = 32% of Basic. HRA = 15% of Basic. CCA = 10% of BASIC, PF = 15% of Basic and print all details with Net pay. All processing should be using pointer notation.
   b) Result is "Pass" if all subject marks are greater than or equal to 50 else "Fail".
   c) Class will be awarded for students who have cleared 3 subjects
   i. Class "Distinction" if average >=75
   ii. Class "First" if average lies between 60 to 74 (both inclusive)
   iii. Class "Second" if average lies between 50 & 59 (both inclusive)
   d) Repeat the above program to manipulate 10 students' details and sort the structures as per rank obtained by them.

15GE207 ENGINEERING GRAPHICS 0 0 4 2

Course Objectives

- To learn conventions and use of drawing tools in making engineering drawings.
- To draw orthographic projections of points, line and solids.
- To draw the section of solids and development of surfaces of the given objects.
- To draw the isometric projections and perspective projections of the given solids.
- To introduce CAD software to draw simple two dimensional drawings.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Recognize the conventions and apply dimensioning concepts while drafting simple objects.
2. Draw the orthographic projection of points, line, and solids.
3. Draw the section of solid drawings and development of surfaces of the given objects.
4. Draw the isometric and perspective projection of the given objects.
5. Draw the simple two dimensional drawings using computer aided drawing tool.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1					1		1		2		1		
2	2					2		2		2		1		
3	2					2		2		2		1		
4	2					3		3		2		2		
5														

UNIT I **12 Hours**

CONVENTIONS AND BASIC DRAWINGS

Importance - conventions - ISO and BIS - drawing tools and drawing sheets - lettering, numbering, dimensioning, lines and Symbols-Conic sections - types constructions -ellipse, parabola and hyperbola - eccentricity and parallelogram method.

UNIT II **14 Hours**

ORTHOGRAPHIC PROJECTIONS

Principles - first and third angle projections - Points - first angle projection of points, straight lines - parallel, perpendicular and inclined to one reference plane, solid - cylinders, pyramids, prisms and cones.

UNIT III **12 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACE

Section of solids - simple illustrations. Development of surfaces - cylinders, pyramids, prisms, cones and simple truncated objects.

UNIT IV **12 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTIONS

Importance - orthographic to isometric projection - simple and truncated solids- perspective projections of simple solids.

UNIT V **10 Hours**

INTRODUCTION TO COMPUTER AIDED DRAWING (NOT FOR END SEMESTER EXAMINATION)

Basics commands of AutoCAD - two dimensional drawing, editing, layering and dimensioning - coordinate Systems -Drawing practice - orthographic views of simple solids using AutoCAD.

Total: 60 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau Of Indian Standards-SP46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V.Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
6. George Omura, Brian C. Benton, Mastering AutoCAD 2015 and AutoCAD LT 2015: Autodesk Official Press, Wiley Publisher, 2015.

15MA201 VECTOR CALCULUS AND COMPLEX ANALYSIS 3 2 0 4

Course Objectives

- Implement the Complex Analysis, an elegant method in the study of heat flow, fluid dynamics and electrostatics.
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Calculus viz: Differentiation, Integration and Vectors.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Determine & apply the important quantities associated with vector fields such as the divergence, curl and scalar potential.
2. Apply the theoretical aspects of vector integral calculus in their core areas.
3. Recognize the differentiation properties of vectors.
4. Identify the complex functions and their mapping in certain complex planes.
5. Use the concepts of integration to complex functions in certain regions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	1	2												
3	1													
4	1	2												
5	3													

UNIT I **10 Hours**

VECTOR CALCULUS

Gradient -Divergence -Curl - Directional derivative- Solenoidal -Irrotational vector fields -Line Integral - Surface integrals.

UNIT II **9 Hours**

INTEGRAL THEOREMS OF VECTOR CALCULUS

Green's theorem in a plane- Stoke's Theorem- Gauss divergence theorem- Applications involving cubes and parallelepiped.

UNIT III **8 Hours**

ANALYTIC FUNCTIONS

Analytic Functions- Necessary and Sufficient conditions of Analytic Function- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method -Applications to the problems of Potential Flow.

UNIT IV **8 Hours**

MAPPING OF COMPLEX FUNCTIONS

Physical interpretation of mapping- Application of transformation: translation, rotation, magnification and inversion of multi valued functions - Linear fractional Transformation (Bilinear transformation).

UNIT V **10 Hours**

INTEGRATION OF COMPLEX FUNCTIONS

Cauchy's Fundamental Theorem - Cauchy's Integral Formula - Taylor's and Laurent's series- Classification of Singularities - Cauchy's Residue Theorem.

FOR FURTHER READING

Applications to Electrostatic and Fluid Flow.

Total: 75 Hours

Reference(s)

1. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-HillPublishing Company Ltd, 2003
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015
3. J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill,New Delhi, 1996
4. B. S. Grewal, Higher Engineering Mathematics, Forty third Edition, Khanna Publications , New Delhi 2014
5. Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition ,Cengage Learning India Private Limited, 2012
6. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India,2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6					8			4			2								22
2	2					4				4					4				6						20
3		2									10								6						18
4	2						4				6				6										18
5	2						4			6				4					6						22
																								Total	100

Assessment Questions

Remember

1. Define gradient of a vector.
2. Define irrotational of a vector.
3. State Green's theorem.
4. State Gauss divergence theorem.
5. Check whether the function is f(z)=z^3 analytic.
6. List the necessary condition for a function f(z) to be analytic.
7. Define Bilinear transformation.
8. State the condition for the transformation w = f(z) to be conformal at a point.
9. State the formula for finding the residue of a double pole.
10. State Cauchy's integral formula.

Understand

1. If $\vec{F} = x^2 \vec{i} + xy^2 \vec{j}$ evaluate the line integral $\int \vec{F}.\vec{dr}$ from (0,0) to (1,1) along the path y=x.
2. Identify the unit normal vector to the surface $x^2 + xy + z^2 = 4$ at the point (1,-1,2)
3. Identify the value of $\nabla x \nabla \Phi$.(F), using Stoke's theorem.
4. Formulate the area of a circle of radius a using Green's theorem .
5. Illustrate the two properties of analytic function.
6. Represent the analyticity of the function w = sin z.
7. Identify fixed points of the transformation w = z^2 .
8. Identify the image of the triangular region in the z plane bounded by the lines x= 0, y = 0, and x + y d = 1 under the transformation w = 2z.
9. Infer $\int_c \frac{dz}{(z-3)^2}$ where c is the circle $|z| = 1$.
10. Identify the residues of the function $f(z) = \frac{4}{z^3(z-2)}$ at its simple pole.

Apply

1. Find $\int_c \overline{F}.dr$ where $\overline{F} = (2y+3)i + xzj + (yz-x)k$ along the line joining the points (0,0,0) to (2,1,1).
2. If $\vec{F} = 3xy\vec{i} - y^2 \vec{j}$, find $\int_C \vec{F} \cdot d\vec{r}$ where C is the curve in the xy-plane y=2x^2 from (0,0) to (1,0).
3. Apply Green's theorem in the plane to Compute $\int_c (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the boundary of the region defined by x=0, y=0 and x+y=1.
4. Using Gauss divergence theorem, Compute $\iint_s \vec{F} \cdot \hat{n} ds \; where \; \vec{F} = 4xz\vec{i} - y^2 \vec{j} + yz\vec{k}$ and S is the surface of the cube bounded by x=0,y=0,z=0,x=1,y=1,z=1.
5. If ω=φ+iψ represent the complex potential for an electric field and $\cdot = x^2 - y^2 + \frac{x}{x^2 + y^2}$, find the function φ.
6. If $u = \log(x^2 + y^2)$, find v and f (z) such that f (z) =u+iv is analytic.

7. Find bilinear transformation which maps the points I,-1,I of the z plane into the Points 0,1,∞ of the w plane respectively.

8. Find the image of the circle $|z-1|=1$ in the complex plane under the transformation $w = \frac{1}{z}$

9. Find Taylor's series f(z) = cos z about z = $\frac{®}{3}$.

10. Find the nature of singularity $z\, e^{\left(\frac{1}{z}\right)^2}$.

Analyze

1. Conclude $div\, grad(r^n) = \nabla^2(r^n) = n(n+1)\, r^{n-2}$

2. Demonstrate the irrotational vector and solenoidal vector with an example.

3. Justify stokes's theorem for $\overline{F} = -yi + 2yzj + y^2k$, where S is the upper half of the sphere $x^2+y^2+z^2=1$.

4. Justify Gauss divergence theorem for $\vec{F} = x^2\, \vec{i} + y^2\, \vec{j} + z^2\, \vec{k}$ where S is the surface of the cuboid formed by the planes x= 0, x= a, y = 0, y = b, z = 0 and z = c.

5. The complex potential f(z)=z^2 describes a flow with constant equipotential lines and streamlines ,Determine the velocity vector.

6. Show that the function $u = x^3 + x^2 - 3xy^2 + 2xy - y^2$ is harmonic and find the corresponding analytic function.

7. Find the image of the rectangle whose vertices are (0,0), (1,0), (1,2), (0,2) by means of linear transformation w = (1+i)z+2-i. Also compare the images.

8. Generate $f(z) = \frac{z}{(z-1)(z-3)}$ as Laurent's series valid in the regions: $1 < |z| < 3$ and $0 < |z-1| < 2$

9. Use Cauchy's integral formula Compute $\int_C \frac{e^z\, dz}{(z+2)\,(z+1)^2}$ where C is the circle $|\, z\, | = 3$.

10. Find $\int_C \frac{z+4}{z^2+2z+5} dz$ where C is $|z+1+i| = 2$.

Evaluate

1. Determine $\iint_s (xdydz + 2ydzdx + 3zdxdy)$,where s is the closed surface of the sphere $x^2 + y^2 + z^2 = a^2$.
2. Prove that $curl(curl\vec{F}) = grad(div\vec{F}) - \nabla^2\vec{F}$.
3. Check Stokes theorem for $\vec{F} = (x^2 + y^2)\vec{i} - 2xy\vec{j}$ taken around the rectangle bounded by x=±a, y=0 y=b.
4. Check Green's theorem in the plane to determine $\int_c (3x^2 - 8y^2)dx + (4y - 6xy)\,dy$ where c is the boundary of the region defined by $(i)\, x = 0, y = 0, x + y = 1 (ii)\, y = \sqrt{x}\, and\; y = x^2$.
5. Determine the analytic function f(z) = P + iQ, if Q = $\dfrac{\sin x \sinh y}{\cos 2x + \cosh 2y}$, if f(0) = 1.
6. Determine f(z) and the conjugate harmonic v such that w = u + iv is an analytic function of z given that u = $e^{x^2 - y^2}\cos 2xy$.
7. Determine the image of the infinite strip $\dfrac{1}{4} \le y \le \dfrac{1}{2}$ under the transformation w = $\dfrac{1}{z}$
8. Determine the Laurent's series expansion $f(z) = \dfrac{z-1}{(z+2)(z+3)}$ $for\;\; 2 < |z| < 3$.
9. Determine $\int_C \dfrac{z+4}{z^2 + 2z + 5}dz$ where C is $|z + 1 + i| = 2$
10. Using Cauchy's integral formula determine $\int_C \dfrac{e^z dz}{(z+2)(z+1)^2}$ where C is $|z| = 1$

15EE205 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING 3 0 0 3

Course Objectives

- To understand the basic concepts of electric circuits
- To analyze the difference between DC and AC circuits
- To Learn the fundamentals of semiconductors and BJT.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Apply the concept of current and voltage law for DC circuits.
2. Analyze the parameters of alternating current and examine the behavior of linear circuits.
3. Explain the constructional details and working of DC machines.
4. Explain the characteristics of semiconductor diodes and design the rectifier circuits.
5. Classify the three different characteristics of BJT.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												1
2	3	2												1
3	2	1												1
4	2	3											2	1
5	1	3												1

UNIT I **9 Hours**

DC CIRCUITS

Definition of Voltage, Current, Power, Energy, Resistor, Inductor and Capacitor-Ohm's law-statement, Illustration and limitation - Kirchoff's Laws statement and Illustration-Resistance in series and voltage division technique - Resistance in parallel and current division technique-Simple problems.

UNIT II **9 Hours**

AC CIRCUITS

Generation of single phase alternating emf - RMS value, average value, peak factor and form factor - Analysis of Pure Resistive, Inductive and Capacitive circuits - J operator - Representation of alternating quantities in rectangular and polar forms - Star-Delta transformation -Simple problems

UNIT III **11 Hours**

ELECTRICAL MACHINES

Constructional details of DC Machines - Principle of operation of D.C. generator - EMF equation - Methods of excitation - Self and separately excited generators - Principle of operation of D.C. motor - Back EMF and torque equation - Transformer Constructional details - Principle of operation- EMF equation - Transformation ratio

UNIT IV **8 Hours**

SEMICONDUCTOR DIODE AND ITS APPLICATIONS

Semiconductor theory - Theory of P-N junction diode - Volt-Ampere Characteristics - PN junction diode current equation - Zener diode - Half wave and full wave rectifier - Average value - RMS value - Form factor - Peak factor - Ripple factor - Efficiency - Peak inverse voltage - Transformer utilization factor - Comparison between Half wave and full wave rectifier circuits.

UNIT V **8 Hours**

BIPOLAR JUNCTION TRANSISTOR

Structure and working of Bipolar Junction Transistor, Input and output characteristics of CE, CB and CC configurations, relation between alpha and beta - Concepts of transistor as an amplifier and transistor as a switch.

FOR FURTHER READING

Light Emitting Diode - Simple House wiring - Clipper and Clampers

Total: 45 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic Electrical and Electronics Engineering, Oxford University Press, 2014

2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2012

3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010

4. William H.Hayt Jr, Jack E.Kemmerly, and Steven M.Durbin, Engineering Circuit Analysis, Tata McGrawHill Publishing Co Ltd, New Delhi, 2012.

5. Jacob. Millman, Christos C.Halkias, Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw Hill Publishing Limited, New Delhi, 3rd Edition 2011

6. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					6				4				6						20
2	4					4				2				6					4						20
3	2				4					4					4				6						20
4	4					6				4					6										20
5	4					4				12															20
																								Total	100

Assessment Questions

Remember

1. State Ohm’s law.
2. State Lenz law.
3. State Faraday’s law of electromagnetic induction.
4. Recall the properties of flux lines.
5. Define reluctance
6. Define average value.
7. List the advantages of three phase system.
8. Define aspect ratio.
9. State the need for modulation.
10. List the applications of diode.

Understand

1. Explain Ohm's law relating to (V), (I) and (R).
2. Compare series and parallel circuits.
3. Interpolate domestic appliances connected in parallel.
4. Classify the magnetic circuits.
5. Explain the concepts of self and mutually induced emf.
6. Explain the laws of electromagnetic induction.
7. Indicate the action of diode in forward and reverse biasing with the help of V-I characteristics.
8. Explain the switching characteristics of diode.
9. Explain briefly the need for modulation.
10. Summarize the advantages of FM over AM.

Apply

1. Three resistors are connected in series across a 12V battery. The first resistance has a value of 2 ohm, second has a voltage drop of 4V and third has power dissipation of 12 W. Calculate the value of the current in the circuit.
2. A 25 ohm resistor is connected in parallel with a 50ohm resistor. The current in 50ohm resistor is 8A. What is the value of third resistance to be added in parallel to make the total line current as 15A.
3. The self inductance of a coil of 500turns is 0.25H.If 60% of the flux is linked with a second coil of 10500 turns. Calculate a) the mutual inductance between the two coils and b) emf induced in the second coil when current in the first coil changes at the rate of 100A/sec.
4. An air cored toroidal coil has 480 turns, a mean length of 30cm and a cross-sectional area of 5 cm2.Calculate a)the inductance of the coil and b) the average induced emf, if a current of 4 A is reversed in 60 milliseconds.
5. A toroidal air cored coil with 2000 turns has a mean radius of 25cm, diameter of each turn being 6cm. If the current in the coil is 10A, find mmf, flux, reluctance, flux density and magnetizing force.
6. Demonstrate the block diagram of the television and explain each block.
7. Show the block diagram of the optical fibre communication and explain each block.
8. Show the block diagram of the satellite communication and explain each block.
9. Convert the current source into voltage source in the below circuit and verify that the voltage **VL** across the load is the same for each source.
10. Demonstrate the applications of diodes.

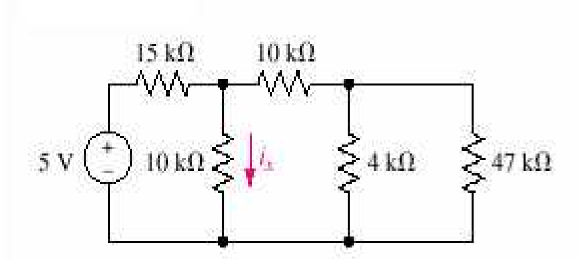
Analyse

1. Criticize the equations for the equivalent star network resistances for a given delta network.
2. Differentiate the expressions for self inductance and mutual inductance.
3. Contrast the series and parallel magnetic circuit and derive the total mmf required.
4. Compare electric and magnetic circuits.
5. Attribute the expression for RMS, average value, peak and form factor of sinusoidal voltage.
6. Identify the voltage, current in a series RL circuit supplied with an alternating voltage.
7. Resolve the phase relation in pure resistor.
8. Resolve the expression for diode current equation.
9. Identify the effect of temperature on P-N junction diode characteristics.
10. Organize the equation of transition capacitance.

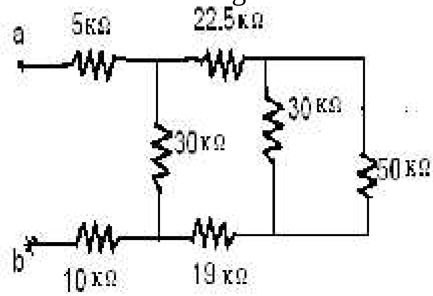
Evaluate

1. An iron rod of 1cm radius is bent to a ring of mean diameter 30cm and wound with 250 turns of wire. Assume the relative permeability of iron as 800. An air gap of 0.1cm is cut across the bent ring. Calculate the current required to produce a useful flux of 20,000 lines if leakage is neglected.

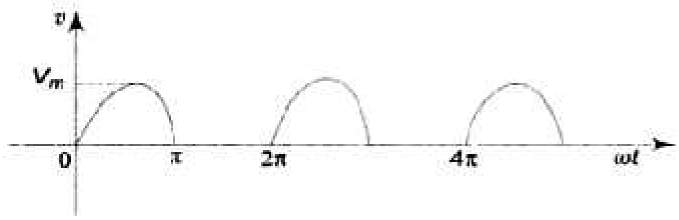
2. For the circuit in Fig. determine i_X,and compute the power dissipated by the 15-kΩ resistor.



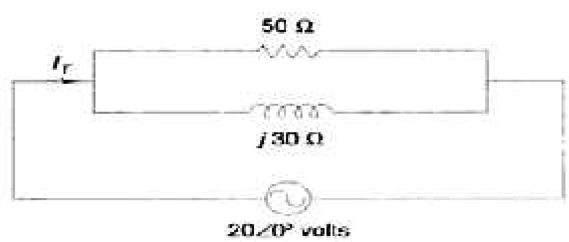
3. Theeffectiveresistanceoftworesistorsconnectedinseriesis100 Ω. When connected in parallel, then effective value in 24 ohm’s. Determinethevalueoftworesistors.
4. Determine the equivalent resistance of the following circuit



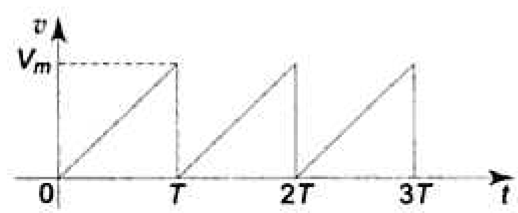
5. Determine the form factor of the half-wave rectified sine wave as shown in fig.



6. Find the total impedance and line current in the circuit shown in fig.



7. Determine the effective value of saw tooth waveform shown in fig.



8. A series circuit consisting of 25Ω resistor, 64Mh inductor and 80μF capacitor, is connected toa1 10V, 50Hz, single phase supply. Calculate the current and the voltage across individual elements.

15EE206 ELECTRIC CIRCUIT ANALYSIS 2 0 2 3

Course Objectives

- To apply the concept of Graph theory and analyze the electric circuits.
- To compute electrical parameters like current, voltage and power using network theorems for AC and DC circuits.
- To differentiate single phase and three phase circuits.
- To analyze R, L, C components for resonance, coupling and transient response.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Apply the concept of Graph theory to analyze the electric circuits.
2. Apply the network theorems to compute various parameters of electric network.
3. Analyze the three phase circuit with different types of loads.
4. Design of tank circuit for given frequency and analyze the coupled circuits in series and parallel.
5. Analyze the transient response of RL, RC and RLC circuits with DC and AC input.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		1										1
2	1	3		1										1
3		2		1										
4	1			2	2									1
5	2	2		1										1

UNIT I **7 Hours**

GRAPH THEORY AND BASIC CIRCUIT ANALYSIS

The graph of a Network, definitions of tree, co-tree, link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix - Duality - Concepts of Impedance and Admittance - Source Transformation - Mesh and Nodal analysis.

UNIT II **5 Hours**

NETWORK THEOREMS FOR DC AND AC CIRCUITS

Superposition theorem - Thevenin's and Norton's theorem - Maximum power transfer theorem- Reciprocity theorem- Millman's theorem.

UNIT III **5 Hours**

THREE PHASE CIRCUITS

Three Phase balanced and unbalanced systems - Analysis of 3 wire and 4 wire circuit with star and delta connected loads - Phasor diagram - power and power factor measurement.

UNIT IV **7 Hours**

RESONANCE AND COUPLED CIRCUITS

Series and parallel resonance - Q factor and bandwidth - Resonant frequency of a tank circuit - Coupled circuits - Self and mutual inductances - Coefficient of Coupling - Analysis of coupled circuits - Dot rule for coupled circuits - Equivalent circuit of coupled circuits - Coupled circuits in Series and Parallel.

UNIT V **6 Hours**

TRANSIENTS

Introduction - Transient Response of RL, RC and RLC Circuits with step and sinusoidal inputs - Time Constant Analysis.

FOR FURTHER READING

Tuned Circuits - Tank circuits - application of second order differential equations.

1 **6 Hours**

EXPERIMENT 1

Verification of Mesh and Nodal analysis.

2 **6 Hours**

EXPERIMENT 2

Verification of superposition theorem.

3 **6 Hours**

EXPERIMENT 3

Verification of Thevenin and Norton theorems.

4 **6 Hours**

EXPERIMENT 4

Power measurement using two wattmeter method.

5 **6 Hours**

EXPERIMENT 5

Frequency Response of a series R-L-C Circuit.

Total: 60 Hours

Reference(s)

1. William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuit Analysis, Eighth Edition, Tata McGraw Hill, 2013
2. Sudhakar and S. P. Shyam Mohan, Circuits and Network Analysis and Synthesis, Fifth Edition, Tata McGraw Hill, 2015
3. Charles K.Alexander, Fundamentals of Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Co Ltd, 2013

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					6			4				6							20
2	4					4				2				6					4						20
3	2					4					4				4				6						20
4	4					6				4					6										20
5	4					4				12															20
																								Total	100

Assessment Questions

Remember

1. Define electric circuit.
2. Classify the electric circuit components.
3. Describe the V-I relationships between the R, L and C.
4. State dependent and independent sources.
5. State superposition theorem.
6. State thevenin's theorem.
7. State norton's theorem.
8. State reciprocity theorem.
9. Define resonance.
10. Recall resonant frequency expression for series resonance circuit.
11. State Q factor.
12. Define bandwidth.
13. Draw the series resonance and parallel curves.
14. List the applications of resonance.
15. Define coupled circuits.
16. Compare self inductance and mutual inductance.
17. Define coefficient of coupling.
18. Describe transient response.

Understand

1. Explain the algorithm for mesh loop current analysis method.
2. Show the V-I relationships between R, L and C.

3. Explicate the algorithm for node voltage method.
4. Compare the current division and voltage division techniques.
5. Show the peak factor value for sinusoidal waveform.
6. Explain the sinusoidal response of the following single phase ac circuits.
   a. Pure resistive circuit
   b. Pure inductive circuit
   c. Pure capacitive circuit.
7. Explain the applications of network theorems.
8. Derive the expressions for current, resonant frequency, quality factor, bandwidth of the circuit, and draw the resonance curve for a series resonance circuit.
9. Derive the expressions for current, resonant frequency, quality factor, bandwidth of the circuit, and draw the resonance curve for a parallel resonance circuit.
10. Explain in detail the concept of implementing any two types of forcing function on assumed RLC circuit, and obtain its transient response.
11. Represent the expression for coefficient of coupling.
12. Compare the transient response of RL, RC and RLC Circuits with step and sinusoidal inputs.

Apply

1. Four resistors of 2 Ω, 3 Ω, 4 Ω, 5 Ω respectively are connected in parallel. What voltage must be applied to the group in order that power of 100watts may be absorbed also find current flowing through the circuit.
2. A resistance R is connected in series with a parallel circuit comprising two resistors 12 Ω and 8 Ω respectively. The total power dissipated in the circuit is 70watts when the applied voltage is 220Volts.Calculate the value of R. In a RLC series circuit consists of resistance 15 Ω, Inductive reactance 7.5 Ω and capacitive reactance 12 Ω are connected with 230 Ω, 50Hz supply. Calculate i) current ii) Power factor iii) Apparent, active & reactive powers iv) Capacitance & Inductance v) Impedance. Also draw the phasor diagram.
3. An inductive coil takes 10A and dissipates 1000 Watts, when connected to supply at 250V, 25Hz. Calculate the resistance, the inductance the impedance and power factor.
4. For the given circuit (Figure 1) discover the branch currents using mesh loop current analysis method.

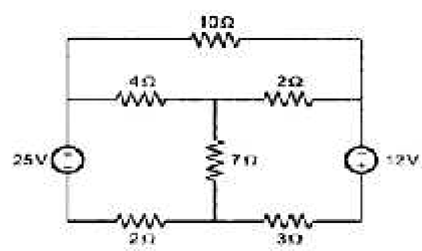


Figure 1

5. Calculate current through 20Ω resistance (Figure 2) by using Thevenin’s theorem.

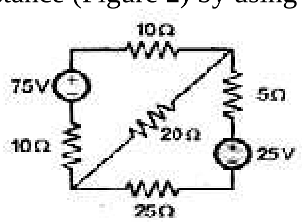


Figure 2

6. Determine current through 10Ω resistance (Figure 3) by Norton's theorem.

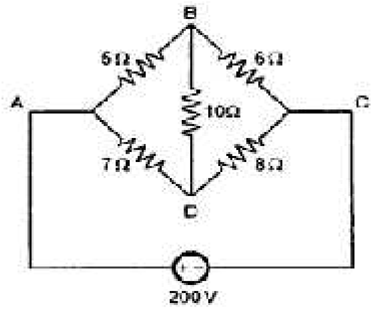


Figure 3

7. Judge the superposition theorem to calculate the current through 5 Ω resistances for the network shown below (Figure 4).

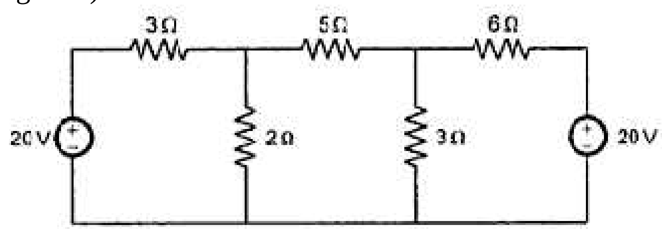


Figure 4

8. Three resistors 25 Ω, 50 Ω and 75 Ω are connected in star. Examine the equivalent delta resistors?

9. In the circuit shown below (Figure 5) switch is closed at t=0. Produce the expression for the current in circuit and find I at t=0.25 sec.

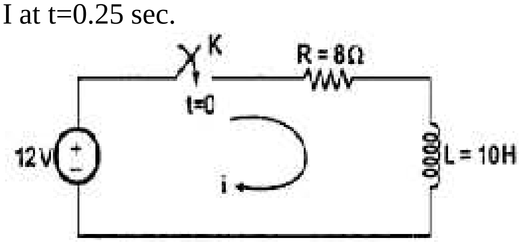


Figure 5

Analyze

1. Design a V-I relationships between the R, L and C.
2. Compare series and parallel circuits.
3. Illustrate the three phase and single phase ac circuits.
4. Justify LC combinations are not used in electric circuit?
5. When the switch is closed at t=0, find the current I (t) and the voltage across R, L & C and analyze it completely.
6. Outline maximum power transfer theorem.
7. Analyze the following
   i) Transient response of RC circuit with step and sinusoidal inputs
   ii) Transient response of RL circuit with step and sinusoidal inputs
   iii) Transient response of RLC circuits with step and sinusoidal inputs

Evaluate

1. Do the following operations and write the result in polar form.
   i) (5+j4) X (-4-j6)
   ii) (-2-j5) / (5+j7)
2. Two impedances 14+j5 ohms and 18+j10 ohms are connected in parallel across a 200V, 50 Hz supply. Construte i) the admittance of each branch and of entire circuit, ii) the total current.
3. List the advantages of time domain analysis of circuits.

Create

1. Propose the node voltages at all points using nodal analysis method for the network (Figure 6) shown below.

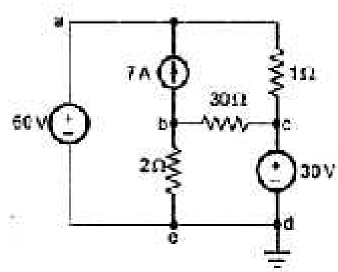
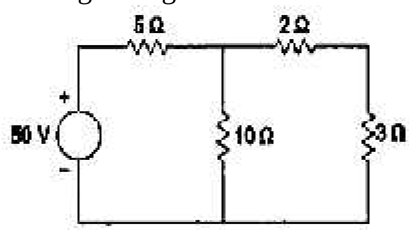
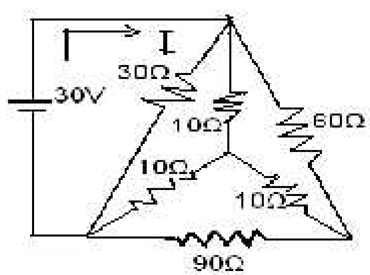


Figure 6

2. Determine the value of current flowing through 3Ωresistor.



3. Reconstruct the phasor diagram for pure resistive circuit.
4. Calculate the total resistance R_T, and total curren I in the following circuits using star delta transformationtechnique



5. Construct the different type of power in single phase a.c. circuits and write their formulae.
6. Propose the transient response expression for parallel RL circuits.

15GE107 WORKSHOP PRACTICE 0 0 2 1

Course Objectives

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making fitting joints and household pipe line connections using suitable tools.
- To develop the skills for preparing the green sand mould and to make simple household electrical connection
- To provide hands on training for dismantling and assembling of petrol engines, gear box and pumps.
- To develop the skills for making wood/sheet metal models using suitable tools

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Prepare and fabricate craft components using cutting, folding and wrapping techniques.
2. Prepare braided and smocked lifestyle articles and decorative using suitable tools.
3. Make / operate / utilize the craft materials
4. Prepare and fabricate craft components using fitting techniques.
5. Prepare and fabricate craft components using forming techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2				2		1			1
2	2				2				2		1			1
3	2				2				2		1			1
4	2				2				2		1			1
5	2				2				2		1			1

1 **2 Hours**

EXPERIMENT 1

Forming of simple object in sheet metal using suitable tools (Example: Dust Pan / Soap Box)

2 **4 Hours**

EXPERIMENT 2

Fabrication of a simple component using thin and thick plates. (Example: Book rack)

3 **2 Hours**

EXPERIMENT 3

Making a simple component using carpentry power tools. (Example: Pen stand/Tool box/ Letter box].

4 **2 Hours**

EXPERIMENT 4

Prepare a "V" (or) Half round (or) Square joint from the given mild Steel flat.

5 **4 Hours**

EXPERIMENT 5

Construct a household pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend

Gate way and Taps (or) Construct a pipe connections of house application centrifugal pump using pipes,bend, gate valve, flanges and foot valve.

6 **4 Hours**

EXPERIMENT 6

Prepare a green sand mould using solid pattern/split pattern.

7 **4 Hours**

EXPERIMENT 7

Construct a domestic electrical wire connections using indicator, one way switch with calling bell, two way switch with lamp, one way switch with fan regulator and one way switch with socket.

8 **4 Hours**

EXPERIMENT 8

Dismantling and assembly of Centrifugal Monoblock / Gear Pump / Gear box.

9 **2 Hours**

EXPERIMENT 9

Dismantling and assembly of two stroke and four stroke petrol engine.

10 **2 Hours**

EXPERIMENT 10

Mini Project(Fabrication of Small Components).

Total: 30 Hours

15MA301 FOURIER SERIES AND TRANSFORMS 3 2 0 4

Course Objectives

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.
2. Formulate a function in frequency domain whenever the function is defined in time domain.
3. Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
4. Classify a partial differential equation and able to solve them.
5. Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	1	2												
3	1													
4	1	3												
5	1													

UNIT I **9 Hours**

FOURIER SERIES

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value.

UNIT II **13 Hours**

LAPLACE TRANSFORM

Laplace Transform- Existence Condition -Transforms of Standard Functions - Unit step function, Unit impulse function- Properties- Transforms of Derivatives and Integrals - Initial and Final Value Theorems - Laplace transform of Periodic Functions - Inverse Laplace transforms.

UNIT III **8 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity

UNIT IV **8 Hours**

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of Second Order Quasi Linear Partial Differential Equations - Fourier Series Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation - Steady State Solution of Two-Dimensional Heat Equation - Fourier Series Solutions in Cartesian Coordinates.

UNIT V **7 Hours**

Z -TRANSFORM

Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution Method- Partial fraction method - Solution of Difference Equations using Z-Transform.

FOR FURTHER READING

Solutions of one dimensional wave equation and heat equations using Laplace transforms method.

Total: 75 Hours

Reference(s)

1. Larry.C.Andrews and Bhimsen.K.Shivamoggi, Integral Transforms for Engineers, First Edition, PHI Learning, New Delhi, 2007
2. Ian.N.Sneddan, The Use of Integral Transforms, Second Edition, McGraw Hill companies, 1972.
3. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, Inc, Singapore, 2008.
4. Peter V. O. Neil,Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012.
5. B.S. Grewal, Higher Engineering Mathematics, Fortieth Edition, Khanna Publications, New Delhi 2007.
6. C. Ray Wylie and C. Louis Barrett,Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					6				6				6						22
2	2					6				6					6				6						26
3		2					2				6							6							16
4		2					6				6				6										20
5	2						2			6									6						16
																								Total	100

Assessment Questions
Remember

1. State the Dirichlet's Conditions.
2. Define even and odd function graphically.
3. List out the complex Fourier transform pair.
4. State convolution theorem in Fourier transforms.
5. Write the condition for the existence of Laplace Transform.
6. Reproduce L (t sin at).
7. State the conditions for classifications of PDE.
8. Write down the value of a^2 in one dimensional wave equation.
9. Recognize $z\{f(n+1)\}$ *in terms of* $\overline{f}(z)$.
10. Recall the Z – Transform of $\cos\left(\frac{n®}{2}\right)$.

Understand
1. Infer the half-range cosine series for the function $f(x) = x, 0 < x < ®$.
2. Interpret the Fourier series of period 2 for the function $f(x) = \begin{cases} ®x & 0 \le x \le 1 \\ ®(2-x) & 1 \le x \le 2 \end{cases}$.
3. Identify the Fourier transform of $f(x) = \begin{cases} 1-|x| & \text{for } |x| \le 1 \\ 0 & \text{for } |x| > 1 \end{cases}$. Hence evaluate $\int_0^\infty \left(\frac{\sin x}{x}\right)^2 dx$ and $\int_0^\infty \left(\frac{\sin x}{x}\right)^4 dx$.
4. Illustrate the Fourier Sine and Cosine transform of e^{-ax} and evaluate $\int_0^\infty \frac{dx}{(a^2+x^2)}$.
5. Exemplify $\int_0^t \sin u \cos(t-u)\, du$ using Laplace Transform .
6. Indicate the inverse Laplace transform of $\frac{z}{(z-1)(z-2)(z-3)}$ by the method of partial fraction.
7. Use convolution theorem to find the inverse Laplace transform of $\frac{8z^2}{(2z-1)(4z+1)}$.
8. Classify the possible solutions of one dimensional wave equation.
9. Formulate $z\{nf(t)\} = -z\frac{dF}{dz}(z)$
10. Summarize Z-transform.

Apply

1. Execute the function $f(x) = |\cos x| \ \ in \ \ (-®, ®)$ to represent as a Fourier series of periodicity 2π.
2. A taut string of length L is fastened at both ends. The midpoint of the string is taken to a height of b and then released from rest in this position. Find the displacement of the string at any time t.
3. Find the Fourier transform of $f(x) = \begin{cases} a - |x| & for \ \ |x| \le a \\ 0 & for \ |x| \ > a \end{cases}$. Hence evaluate $\int_0^\infty \left(\frac{\sin x}{x}\right)^2 dx$ and $\int_0^\infty \left(\frac{\sin x}{x}\right)^4 dx$.
4. Find the Fourier transform of $f(x) = \begin{cases} 1, & for \ |x| < a \\ 0, & for \ |x| > a \end{cases}$ hence evaluate $\int_0^\infty \frac{\sin x}{x} dx$ and $\int_0^\infty \left(\frac{\sin^2 x}{x^2}\right) dx$
5. Verify the initial and final value theorem for the function $1 + e^{-2t}$.
6. Find $L\left(\frac{\cos 2t - \cos 3t}{t}\right)$
7. Using Convolution theorem find the inverse Laplace transform of $\frac{1}{s^2(s^2+25)}$.
8. Find $L^{-1}\left(\frac{p^2 - p + 2}{p(p+2)(p-3)}\right)$ using Partial fraction method.
9. Using Convolution theorem evaluate $z^{-1}\left(\frac{z^2}{(z-1)(z-3)}\right)$.
10. Solve the differential equation $y(n+3) - 3y(n+1) + 2y(n) = 0 \ \ given \ \ that \ \ y(0) = 4, \ y(1) = 0 \ and \ \ y(2) = 8$.

Analyze

1. Obtain the sine series for $f(x) = \begin{cases} x \ \ in \ \ 0 < x < l/2 \\ l - x \ \ in \ \ l/2 < x < l \end{cases}$ in the interval $(0, l)$.
2. A tightly stretched string of length 'ℓ' fastened at both ends. The mid-point of the string taken to a height 'b' and show that the displacement at any time 't' is given by
$$y(x,t) = -\frac{8b}{®^2}\left[\frac{1}{1^2}\sin\left(\frac{®x}{\ell}\right)\cos\left(\frac{®at}{\ell}\right) - \frac{1}{3^3}\sin\left(\frac{3®x}{\ell}\right)\cos\left(\frac{3®at}{\ell}\right) + \ldots\ldots\right].$$
3. Organize the Fourier transform of f(x) given by $f(x) = \begin{cases} a^2 - x^2 & for \ \ |x| \le a \\ 0 & for \ \ |x| \ge a \end{cases}$. Hence evaluate $\int_0^\infty \left[\frac{\sin t - t\cos t}{t^3}\right] dt = \frac{®}{4}$.
4. Evaluate $\int_0^\infty \frac{dx}{(x^2+a^2)(x^2+b^2)}$ using transform method.
5. Organize the Fourier sine and cosine transform of $f(x) = \begin{cases} x, \ 0 < x < 1 \\ 2 - x, \ 1 < x < 2 \\ 0, \ x > 2 \end{cases}$.

6. Prove that the Laplace Transform of the triangular wave of period 2® defined by

f (t) = $\begin{cases} t & , 0 \le t \le ® \\ 2® - t & , ® < t < 2® \end{cases}$ is $\frac{1}{s^2}\tan h\left(\frac{®s}{2}\right)$.

7.Organize the inverse Laplace transform of $\frac{s+2}{s^2-4s+13}$ using partial fraction.

8. Solve using Laplace Transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=te^{-t}$; $y(0)=0;\ y'(0)=-1$.

9. Find $z^{-1}\left(\frac{z^2}{(z+2)(z^2+4)}\right)$ by the method of partial fraction.

10. Using Z – Transform solve
$y(n)+3y(n-1)-4y(n-2)=0,\ n\ge 2\ \text{given that}\ y(0)=3\ \text{and}\ y(1)=-2$.

Evaluate

1. Determine the Fourier series of the function f(x) of Period 2π given by $f(x)=\begin{cases} 1+\frac{2x}{®} & in\quad -® \le x \le 0 \\ 1-\frac{2x}{®} & in\quad 0 \le x \le ® \end{cases}$

2. A string is stretched between two fixed points at a distance 2ℓ apart and the points of the string are given initial velocities 'u' where $u=\begin{cases} \frac{cx}{\ell}, & in\ 0<x<\ell \\ \frac{c}{\ell}(2\ell-x) & in\,\ell<x<2\ell \end{cases}$ x being the distance from one end point. Find the displacement of the string at any subsequent time.

3. Use transforms method to evaluate $\int_0^\infty \frac{dx}{(x^2+1)(x^2+4)}$

4. Determine the Fourier cosine transform of $e^{-a^2x^2}$. Hence prove $e^{-\frac{x^2}{2}}$ is a self-reciprocal.

5. Choose the Laplace transform of the function f(t) with period $\frac{2®}{μ}$, where f(t) =

$\begin{Bmatrix} \sin μt & , for\ 0<t<®/μ \\ 0 & , for\ ®/μ<t<2®/μ \end{Bmatrix}$.

6. Using Laplace Transform evaluate $\int_0^\infty te^{-3t}\sin 2t\ dt$

7. Using Convolution theorem find the inverse Laplace transform of $\frac{1}{s^2(s^2+25)}$.

8. Solve using Laplace Transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=te^{-t}$; $y(0)=0;\ y'(0)=-1$.

9. Solve the equation $y_{n+2}-7y_{n+1}+12y_n=2^n$, $given\ that\ y_0=y_1=0$.

10. Evaluate inverse Z-transform of $\frac{z}{(z-1)(z-2)(z-3)}$ by the method of partial fraction.

15EI302 ELECTRICAL MACHINES 2 0 2 3

Course Objectives

- To impart knowledge on constructional details, principle of operation, performance characteristics and starters of D.C machines
- To understand the constructional details, principle of operation, equivalent circuit and performance of transformers
- To identify the constructional details, types, principle of operation and performance of single phase and three phase induction motors
- To understand the constructional details and principle of operation of synchronous machines
- To know the constructional details and principle of operation of special machines

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Examine the characteristics and speed control of DC machines.
2. Calculate the transformer equivalent circuit parameters
3. Interpret the construction, working principle and characteristics of single phase and three phase induction motors
4. Analyze the principle of operation and characteristics synchronous machines
5. Select appropriate special motor for suitable applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		1										
2	2	3		1										
3	2	3		1										
4	2	2		1										
5	2	2		1										

UNIT I **6 Hours**

D.C. MACHINES

DC Generator: Principle of operation - Classifications - Characteristics and Applications of series, shunt and compound generators - DC Motor: Principle of operation - Types - Characteristics and Applications of series, shunt and compound motors - Starting of DC motors - Working of two point, three point and four point starters

UNIT II **6 Hours**

TRANSFORMERS

Principle of operation - Transformer on no load and load - Parameters referred to HV/LV windings - Equivalent circuit - Regulation - Testing - Load test, open circuit and short circuit tests - Problems on equivalent circuit

UNIT III **7 Hours**

SINGLE PHASE AND THREE PHASE INDUCTION MOTORS

Single Phase Induction Motor: Construction - Working principle - Types - Split Phase Induction Motor - Capacitor Start Induction Motor - Capacitor Start and Capacitor Run Induction Motor - Shaded Pole Induction Motor - Applications - Three Phase Induction Motor: Principle of operation - Squirrel Cage rotor - Wound rotor - Torque equation - Torque-Slip Characteristics - Applications

UNIT IV **6 Hours**

SYNCHRONOUS MACHINES

Construction and Types of synchronous machines - emf equation - Principle of operation of Synchronous motor - Synchronous condenser - V curves and Inverted V curves - Applications of Synchronous Motors

UNIT V **5 Hours**

SPECIAL MOTORS

Brushless DC motor - Reluctance motor - Hysteresis motor - Variable reluctance Stepper motor - Permanent magnet stepper motor - Universal motor

FOR FURTHER READING

Speed control of DC motor -Instrument transformers-Cooling methods for transformer

1 **6 Hours**

EXPERIMENT 1

Load test on DC shunt motor

2 **6 Hours**

EXPERIMENT 2

Speed control of DC shunt motor.

3 **6 Hours**

EXPERIMENT 3

Load test on single phase transformer

4 **6 Hours**

EXPERIMENT 4

Open circuit and short circuit test on single phase transformer

5 **6 Hours**

EXPERIMENT 5

Load test on single phase induction motor.

Total: 60 Hours

Reference(s)

1. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, 2014
2. B.L.Theraja, Textbook(s) of Electrical Technology, S.Chand publications, 2012
3. S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill publishing company Ltd, 2012
4. Siskind, Electrical Machines, 2012
5. A.E.Fitzgerald and Stephen Umans, Electric Machinery, Tata McGraw Hill publishing company Ltd, 2010
6. A.E.Fitzgerald and Stephen Umans, Electric Machinery, Tata McGraw Hill publishing company Ltd, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2					2					6			4				6							20
2	4					4				8				6					4						26
3	2					4					4				4				6						20
4	4					6				4					6										20
5	4					4				6															14
																								Total	100

Assessment Questions

Remember

1. List out the main parts of DC machine.
2. Identify the purpose of commutator in DC machine
3. DC supply never applied to transformer - Justify
4. Define the all-day efficiency of a transformer.
5. Define slip of an induction motor.
6. Draw the power stages of an induction motor.
7. State the function of synchronous condensers.
8. List any four advantages of brushless DC motor.
9. Define universal motor.
10. List the three types of dc motor starters.
11. Identify the purpose of laminating the core in a transformer.
12. Define equivalent circuit of the transformer.
13. Define voltage regulation of a transformer.
14. Classify single phase induction motors.
15. Identify the usage of centrifugal switch in single induction motor.
16. List any two applications of shaded pole induction motors.
17. Classify three phase induction motors.

18. List any four applications of three phase induction motors.
19. Define synchronous speed.
20. State pitch factor of an armature winding.
21. Define distribution factor.
22. Define voltage regulation of an alternator.
23. Define hunting.
24. List any four applications of synchronous motor.
25. Identify the rating of the single phase machine.
26. State the working principle of brushless DC motor.
27. State the working principle of hysteresis motor.
28. Define step angle.
29. List the three types of stepper motors.

Understand

1. Compare the V and inverted V curves of synchronous motor.
2. Represent synchronous motor adjust itself to an increasing shaft load.
3. Identify the function of brushes in dc generator and dc motor.
4. Classify dc generators.
5. Infer the significance of back emf in dc motors.
6. Why dc series motor should be started with load?
7. Indicate the function of a no-voltage release coil provided in a dc motor starter.
8. Exemplify the internal and external characteristics of dc shunt, dc series and dc compound generators.
9. Illustrate the electrical and mechanical characteristics of three types of dc motors.
10. Differentiate between step up and step down transformers.
11. Does the transformer draw any current when secondary is open? Why?
12. Why transformers are rated in kVA?
13. The efficiency of a transformer is always higher than that of rotating electrical machines. Why?
14. The no load of a 50 Hz single phase transformer is 6600/330v. Find the number of turns in each winding if the maximum flux is to be about 0.06wb in the core.
15. Compare open circuit and short tests on transformer.
16. Derive an equivalent circuit of a single-phase transformer and show how it is useful in the analysis of the performance of a transformer.
17. With neat circuit diagram, explain the open circuit and short circuit tests on single phase transformer.
18. Differentiate between capacitor start and capacitor start and capacitor run induction motors.
19. How will you reverse the direction of rotation of a capacitor start induction run motor?
20. Illustrate the construction and working of split-phase induction motor.
21. Illustrate the construction and working of capacitor start and capacitor run induction motor.
22. Derive the torque equation of three phase induction motor.
23. Why an induction motor is called asynchronous motor?
24. The air gap length is kept minimum in induction motor. Why?
25. Why is the efficiency of a three phase induction motor less than that of a transformer?
26. Illustrate the construction and principle of operation of three phase induction motor.
27. Justify – Why the value of regulation calculated by synchronous impedance method is more than the actual value?
28. Justify – Why a synchronous motor has no starting torque?
29. A synchronous motor always runs at synchronous speed. Why?
30. Does change in excitation affect the power factor of the synchronous motor?
31. Exemplify the concepts of EMF method to determine the voltage regulation.
32. Explain the construction and principle of operation of synchronous motor.

33. Demonstrate the concepts of MMF method to determine the voltage regulation.
34. Illustrate the construction and working principle of variable reluctance stepper motor.
35. Explain the construction and working principle of permanent magnet stepper motor.
36. Demonstrate the construction and working principle of reluctance motor.
37. Illustrate the construction and working principle of hysteresis motor.
38. Demonstrate the construction and working principle of brushless DC motor.

Apply

1. With neat sketch, explain the working of a three point starter.
2. A 10 kVA, 200/400 V, 50 Hz single phase transformer gave the following test results.

O.C. Test:	200 V	1.3 A	120 W	(H.V. Side)
S.C. Test:	22 V	30 A	200 W	(L.V. Side)

Calculate
i) Magnetizing current and the current corresponding to the core loss at terminal voltage and frequency.
) Parameters of equivalent circuit as referred to low voltage winding.

Analyse

1. Differentiate between lap and wave windings used in dc machine.
2. How will you change the direction of rotation of a dc motor?
3. Under what condition the mechanical power developed in a dc motor will be maximum?
4. The Armature of a 4-pole DC motor has lap connected winding accommodated in 60 slots, each containing 20 conductors. If the useful flux per pole is 25mwb, calculate the torque developed when the armature current is 60A.
5. The secondary of a 500kVA, 5000/500v transformer has 100 turns, Calculate i) Primary turns ii) Primary and secondary full load currents, neglecting losses.
6. A single-phase 50 Hz core type transformer has a rectangular core 20 X 15cms and the maximum allowable flux density is 1 wb per Sq.m. Find the number of turns on the high and low voltage sides for a voltage ratio of 3300/330v.
7. The test results of a 20 kVA, 1000/250 V, 50 Hz single phase transformer are as follows:

O.C. Test:	1000 V	1.75 A	300 W	(H.V. Side)
S.C. Test:	5.5 V	60 A	180 W	(L.V. Side)

8. Determine the transformer constants and also draw the equivalent circuit.
9. Why single phase induction motor is not self starting?
10. Draw and explain the torque-slip characteristic of an induction motor and also mark starting torque and maximum torque on the curve.
11. Illustrate the synchronous motor V curves and inverted V curves.
12. Compare the reluctance motor and induction motor.
13. Differentiate between synchronous motor and hysteresis motor.
14. Differentiate between variable reluctance and permanent magnet stepper motors.

15EI303 FLUID AND SOLID MECHANICS 3 0 0 3

Course Objectives

- To impart knowledge on simple stresses, strains and elastic constants
- To enhance the student's knowledge on fluid statics, kinematics and dynamics
- To impart knowledge on the fluid properties and application to real situations of fluid flow

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Determine the different types of stress, strain and Elastic constants
2. Evaluate shear force and bending moment for cantilever, simply supported and over hanging beams for any type of loading
3. Interpret the fundamentals properties of fluid systems
4. Evaluate the losses in a pipe flow using discharge measuring devices
5. Classify pumps and explain their working principles

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2	1										
2	3		2	1										
3	3		2											
4	3		2	1										
5	3		2											

UNIT I **9 Hours**

SIMPLE STRESSES AND STRAINS

Tension, compression and shear stresses - Hookes law - stress - strain diagram for mild steel - ultimate stress and working stress - Elastic constants and relationships between them - composite bars - Temperature stresses - Relationship between stress and strain

UNIT II **9 Hours**

BEAMS AND BENDING

Types of beams - Types of supports - shear force and bending moment of beams. Sketching of shear force and bending moment diagrams for cantilever, simply supported and over hanging beams for any type of loading - Relationship between rate of loading, shear force and bending moment

UNIT III **9 Hours**

FLUID PROPERTIES AND KINEMATICS

Fundamental units - mass density - specific weight - viscosity - surface tension- capillarity - compressibility. Streamline - streak line - path line - continuity equation

UNIT IV **9 Hours**

FLUID DYNAMICS AND FLOW THROUGH PIPES

Stream and potential functions - Laminar flow, Turbulent flow - Bernoullis equation - Darcys equation - Pipes in series and parallel - major and minor losses - hydraulic grade line - venturi meter - orifice meter - manometer.

UNIT V **9 Hours**

HYDRAULIC PUMPS

Classification of pumps - Centrifugal pumps - Multistage pumps - Minimum speed to start the pump - Specific speed and characteristic curves - Reciprocating pumps - Negative slip - Indicator diagram

Total: 45 Hours

Reference(s)

1. S. Ramamrutham, Strength of Materials, Dhanpat Rai and Publication, 2010
2. R.K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2011
3. R. K. Rajput, A Text book of Fluid Mechanics and Hydraulic Machines, S. Chand and Co. Ltd., 2011
4. B. C. Punmia, Ashok K. Jain and Arun K. Jain, Mechanics of Materials, Laxmi Publications, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	7					10																			17
2	7					10																			17
3	4					6			4																14
4	7					12																			19
5	5					10																			15
6	6					12																			18
																								Total	100

Assessment Questions

Remember

1. Define stress.
2. Define strain.
3. State Hooke’s law.
4. Define Elasticity.
5. Give the relationship between bulk modulus, young’s modulus and poisson’s ratio.
6. What is the necessity of calculating the values of thermal stresses in structural members?
7. What are the types of beams?
8. What are the different types of end conditions in a beam?
9. What are the different types of loads?
10. Define shear force and bending moment
11. What do you mean by point of contraflexure
12. Define fluids.
13. Enumerate the important fluid properties with their units of measurement.
14. List the various pressure measuring instruments.
15. What is an incompressible fluid flow?
16. List the forces present in fluid flow.
17. What is Euler’s equation of motion?
18. State Bernoulli’s theorem.
19. What is specific speed of the turbine?
20. How pumps are classified?

Understand

1. Draw the stress strain curve of a ductile material.
2. Draw the shear force and bending moment diagram for a simply supported beam subjected to a couple
3. How are fluids classified?
4. Explain the importance of viscosity in fluid flow.
5. What do you understand by Continuity Equation?
6. Under what conditions one can treat real fluid flow as irrotational.
7. List the properties of stream function
8. State the assumptions used in deriving Bernoulli’s equation.
9. Mention the applications of Bernoulli’s equation.
10. Compare venture meter with orifice meter and mention the advantages of venture meter.
11. Discuss in brief how and when separation of flow takes place in a reciprocating pump.
12. Differentiate between the volute casing and vortex casing for the centrifugal pump.

Apply

1. How will you calculate yield stress?
2. How will you calculate ultimate stress?
3. Why does the viscosity of a gas increases with the increase in temperature while that of a liquid decreases with increase in temperature?
4. Sketch the velocity distribution for uniform irrotational flow.
5. Derive the continuity equation for three dimensional flow.
6. Describe the use and limitations of the flow nets.
7. Drive Bernoulli’s equation for the flow of an incompressible fluid.
8. Explain the principle of venturimeter with a neat sketch. Derive the expression for the rate of flow of fluid through it.
9. What would happen if cavitations occur in centrifugal pump?

15EI304 APPLIED THERMODYNAMICS 3 0 0 3

Course Objectives

- To study the fundamentals and laws of thermodynamics
- To understand the basic concepts of various thermal applications like Internal Combustion engines, Gas turbines, steam boiler, steam turbine and compressors
- To provide the functions of steam nozzles and steam turbines
- To impart the knowledge on working principles and performance of air compressors
- To study the working principle and applications of refrigeration and air conditioning systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Exemplify the basic concepts and laws of thermodynamics
2. Understand the concept of air standard cycles and the working of internal combustion engine
3. Resolve the problems involving steam nozzles and steam turbines
4. Demonstrate the working and analyze the performance of air compressors
5. Evaluate the performance of refrigeration and air conditioning system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2											
2	3		2											
3	3		2											
4	3		2											
5	3		2											

UNIT I **9 Hours**

BASIC CONCEPTS AND LAWS OF THERMODYNAMICS

Thermodynamic systems - Boundary - Control volume - System and surroundings - Universe - Properties - State-process - Cycle - Equilibrium - Work and heat transfer - Point and path functions - First law of thermodynamics for open and closed systems - steady flow energy equations - Second law of thermodynamics - Heat engines - Refrigerators and heat pumps - Carnot cycle - Clausius inequality - Entropy

UNIT II **9 Hours**

INTERNAL COMBUSTION ENGINES AND AIR STANDARD CYCLES

Internal combustion engines-Classification- Air standard cycles: Otto, diesel and dual cycles - comparison of efficiency. Gas Turbines - Brayton cycle -Open and closed cycle - Ideal and actual cycles.Working Principle of four stroke and two stroke engines - spark and compression ignition engines - Applications of Internal Combustion engines

UNIT III **8 Hours**

STEAM BOILERS AND TURBINES

Formation of steam - Properties of steam - Steam power cycle, High-pressure boilers - Mountings and accessories. Steam turbines: Impulse and reaction principle - Velocity diagrams - Compounding and governing methods of steam turbines - Layout and working principle of a steam power plant

UNIT IV **9 Hours**

COMPRESSORS

Classifications of compressors -Positive displacement compressors, Reciprocating compressors - Indicated power, Clearance volume, various efficiencies, Clearance ratio, Conditions for perfect and imperfect intercooling and Multi stage with intercooling.Rotary positive displacement compressors - Construction and working principle of centrifugal and axial flow compressors

UNIT V **10 Hours**

REFRIGERATION AND AIR CONDITIONING

Refrigeration - Basic functional difference between refrigeration and air conditioning - Terminologies of refrigeration- refrigerants - Vapour compression cycle and Pressure-Enthalpy and Temperature-Entropy diagram - Saturation cycles - Effect of sub cooling and super heating - Vapour absorption: Air-conditioning systems - Terminologies of psychrometry - Simple psychometric processes - summer, winter, window and central air conditioning

FOR FURTHER READING

Steam Turbine, Pressure Cooker, Steam Nozzles - Applications of IC engines - Cogeneration Steam power plant - axi-centrifugal compressors , mixed-flow compressors- Domestic Refrigerator, Automobile Air Conditioning Systems ,Thermoelastic cooling

Total: 45 Hours

Reference(s)

1. Mahesh M Rathore , Thermal Engineering ,Tata McGraw Hill, New Delhi, 2011
2. Nag P.K., Basic and Applied Engineering Thermodynamics, Tata McGraw Hill, New Delhi, 2008
3. Stephen R. Turns, Thermodynamics Concepts and Applications, Cambridge University Press, 2006
4. Eastop and McConkey, Applied Thermodynamics and Engineering,Pearson Education Ltd,2009
5. Mathur M.L. and Metha F.S., Thermal Engineering, Jain Brothers, New Delhi, 2009
6. Sankaar B.K., Thermal Enginerring, Tata McGraw Hill, New Delhi, 2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2					2					6			4				6							20
2	4					4				8				6					4						26
3	2					4					4				4				6						20
4	4					6				4					6										20
5	4					4				6															14
																								Total	100

Assessment Questions

Remember

1. Define Intensive and Extensive property with examples.
2. Define path, process, and cycle.
3. State Kelvin-plank statement of second law of thermodynamics.
4. Define refrigerator.
5. Define heat engine.
6 Define ton of refrigeration and COP.

Understand

1. What is meant by steady flow system?
2. What is the effect of Cut-off ratio in the efficiency of a Diesel cycle?
3. What are the limitations of first law of thermodynamics?
4. Sketch the P-V diagram of dual cycle and mark the processes.
5. Find out the specific volume of at a temperature of 200º C and 0.7 dry.
6. What is the similarity between Diesel and Dual cycle?
7. What is meant by COP?
8.Write the difference between Refrigerator and Air Conditioner.

Apply / Evaluate

1. How will you classify the Internal Combustion engines?
2. How the ignition takes place in C.I. Engine?
3. Find out the specific volume of at a temperature of 200º C and 0.7 dry.
4. For the same compression ratio and heat rejection, which is most efficient: Otto, Diesel or Dual? Explain with PV and TS diagrams.
5. How the use of multistage compression improves the volumetric efficiency of air compressor?
6. Compare steady state and unsteady state heat transfer.
7. Find the enthalpy and entropy of the dry steam at a pressure of 30 bar.
8. Determine the molecular volume of any perfect gas at 600 N/m2 and 30ºC. Universal gas constant may be taken as 8314 J / kg mole – K.
9. Differentiate impulse and reaction turbines.
10.How will you increase the Cooling Effect in Refrigerator?

Create

1. Design the efficiency and mean pressure for petrol engine working with the compression ratio of 5.5. The pressure and temperature at the beginning of the compression are 1bar and 300k respectively. The peakpressure is 30bar. Assume ratio of specific heats to be 1.4 for air. (Use of standard steam tables and refrigeration tables are permitted)

15EI305 ELECTRON DEVICES AND CIRCUITS 3 2 0 4

Course Objectives

- To recall the operation of various semiconductor devices
- To illustrate the characteristics of BJT and FET
- To explain the operation of amplifiers and oscillators

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Outline the construction and characteristics of semiconductor devices.
2. Design biasing and modeling circuits for amplifier using BJT
3. Design biasing and modeling circuits for amplifier using FET
4. Implement design procedure for feedback circuit and five type of oscillator circuits.
5. Construct the differential amplifier circuits and tuned amplifier circuits using BJT and FET.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1										
2	3	2	2	1										
3	3	2	2	1										
4	3	3	2	2										
5	3	3	2	2										

UNIT I **10 Hours**

SEMICONDUCTOR DEVICES

Introduction to semiconductor devices - Construction and V-I Characteristics: P-N junction diode, Zener diode, UJT, SCR, Diac, Triac, BJT - Construction and Drain and Transfer characteristics: JFET and MOSFET.

UNIT II **10 Hours**

BJT: BIASING AND MODELING

Operating Point, Fixed bias, Emitter stabilized bias, Voltage divider bias - BJT Modeling, Determination of h-parameters, Analysis of a transistor amplifier circuit using h-parameters.

UNIT III **8 Hours**

FET: BIASING AND MODELING

Fixed bias, Self bias, Voltage divider bias - FET small signal model, Fixed bias configuration, Self bias configuration, Voltage divider bias configuration.

UNIT IV **9 Hours**

FEEDBACK CIRCUITS AND OSCILLATOR CIRCUITS

Feedback concepts, Feedback conncetion types, Practical feedback circuits - Theory of sinusoidal oscillators - Phase shift oscillator, Wien bridge oscillator - Colpitt's oscillator, Hartley oscillator, Crystal oscillator.

UNIT V **8 Hours**

DIFFERENTIAL AMPLIFIER AND TUNED AMPLIFIER

Differential amplifiers: Common mode analysis, differential mode analysis, DC analysis, AC analysis - Tuned amplifiers: Characteristics, Single tuned amplifiers, double tuned amplifiers.

FOR FURTHER READING

Design of constant DC voltage source, Transistor as an amplifier, FET as a switch, Quartz clock, differential amplifier in operational amplifier, Tuning of sound system.

Total: 75 Hours

Reference(s)

1. Jacob. Millman, Christos C. Halkias and Sathyabrata Jit, Electronic Devices and Circuits, Tata McGraw Hill, New Delhi, 2011
2. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory, Pearson Education, Tenth edition, 2012
3. Theodre F. Boghert, Electronic Devices & Circuits, Pearson Education, Sixth edition, 2011
4. Solid State Circuits, NPTEL - IIT, Chennai, Link: http://nptel.iitm.ac.in/courses.php

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	2			1	6				2	6														18
2	2				2	2					6		2	2											16
3	1	1			1	2			1					2	6				6						20
4		2					6						2		12										22
5	1				1	2	4		2	6			2						6						24
																								Total	100

Assessment Questions

Remember

1. Mention the conditions of proper JFET biasing.
2. List out the applications for zener diode.
3. What is valley voltage of tunnel diode?
4. Draw the characteristics curve for transistor.
5. Define current amplification factor in CC transistor.
6. Mention the values of input resistance in CB, CE & CC configuration?
7. Why voltage divider bias is commonly used in amplifier circuits?
8. How FET is known as voltage variable resistor?
9. How self-bias circuit is used as constant current source?
10. Why self-bias technique is not used in enhancement type MOSFET?
11. Mention the types of IC voltage regulator.
12. State conversion efficiency.
13. Which of the transistor circuit is stable? Why?
14. Mention the conditions of proper transistor biasing?
15. In which region the JFET act as a simple resistor and why?

Apply

1. Discuss the biasing circuits of BJT and its operating point.
2. Construct an equation for differential gain and CMRR.
3. Construct an expression for frequency of oscillation of transistorized Colpitt‘s oscillator.
4. Construct an expression for frequency of RC phases shift oscillator.
5. Prove that oscillations will not be sustained if, at the oscillator frequency, the magnitude of the product of the transfer gain and feedback factor is less than unity.
6. A differential amplifier has a differential gain Ad of 100. The input voltages applied areV1=1mv and V2=0.9mv. Calculate the output voltage for a) CMRR=100 b) CMRR=1000 and c) CMRR=10,000.
7. 20. A differential amplifier has a differential gain Ad of 120. The input voltages applied are V1=1mv and V2=0.9mv. Calculate the output voltage for a) CMRR=100 b) CMRR=1000 and c) CMRR=1000.
8. Construct the expression for single and double tuned amplifiers.
9. Why SCRs are required to be connected in parallel? What are the problems associated with parallel connection of SCRs? How they are eliminated?
10. A germanium diode carries a current of 10mA when a forward bias of 0.2V is applied. a) Estimate the reverse saturation current (Is), b) Calculate bias voltages needed for diode currents of 1mA and 100mA. Comment on the range of these two voltages.

Analyse

1. How are the amplifiers classified based on the bias conditions?
2. BJT is known as current controlled device. Justify.
3. FET is known as voltage variable resistor. Justify.
4. FET is known as voltage controlled device. Justify.
5. How self-bias circuit is used as constant current source?
6. CMRR for the differential amplifier should be high. Comment.
7. Explain how to stabilize the amplitude against variation due to fluctuations occasioned in Wien bridge oscillator.
8. Show that the gain of Wien bridge oscillator using BJT amplifier must be at least three for the oscillations to occur.
9. Analyze the below two statements.

(a) A p-n junction is a robust device and is a good choice for a diode required in power electronics.
(b) Due to the nonlinear, exponential nature of the current, the p-n junction can be used as a Varistor.

10. Give real-time applications for single and double tuned amplifiers.

Create

1. Relate the working of transistor digital switch.
2. Relate the working of zener diode and voltage regulator.
3. Design a radio transmitter and receiver in printed circuit board using various types of oscillators.

15EI306 DIGITAL LOGIC CIRCUITS 3 2 0 4

Course Objectives

- To study various number systems and to simplify the mathematical expressions using Boolean functions
- To study the implementation of combinational circuits
- To study the design of various synchronous and asynchronous circuits
- To expose the students to various memory devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Understand the fundamental concepts of digital circuits and analyze using both traditional techniques.
2. Create a gate-level implementation of a combinational logic function described by a truth table using logic gate.
3. Use the functionality of flip-flops for analysis and design of sequential circuits.
4. Use the concept of state and state transition for analysis and design of sequential circuits.
5. Analyze the digital system design using PLD and interpret the logic families.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1										1	
2	2	3	3										2	
3	2	2	3										1	
4	1	2	3										1	
5	2	3	3	-		-								

UNIT I **9 Hours**

NUMBER SYSTEM

Review of number system; Types and conversion codes - Boolean algebra: De-Morgan's theorem - switching functions and simplification using K-maps & Quine McCluskey method.

UNIT II **9 Hours**

COMBINATIONAL CIRCUITS

Design using logic gates - Design of adders, subtractors, comparators, code converters, encoders, decoders, Multiplexers and demultiplexers -Function realization using multiplexers.

UNIT III **9 Hours**

SYNCHRONOUS SEQUENTIAL CIRCUITS

Flip flops - SR, JK - MSJK, D and T - Shift Registers - Analysis of synchronous sequential circuits; Design of synchronous sequential circuits - Counters, state diagram; state reduction; state assignment.

UNIT IV **9 Hours**

ASYNCHRONOUS SEQUENTIAL CIRCUITS

Analysis of asynchronous sequential machines - State assignment - Asynchronous design problem - Difference between Synchronous and Asynchronous Sequential Circuits.

UNIT V **9 Hours**

LOGIC FAMILIES AND MEMORY DEVICES

Logic Families: TTL, ECL, CMOS - Memories: ROM, PROM, EPROM - Study of memory ICs - Control signals and their programming - Programmable Logic Devices: PLA, PAL, PLD and FPGA.

FOR FURTHER READING

Realizing the Digital Logic Circuits Concept using Virtual Instrumentation: Logic Gates, Half Adder, Full Adder, Code Converters, Multiplexer and De-multiplexer.

Total: 75 Hours

Reference(s)

1. Floyd, Digital Fundamentals, Pearson Education, 2015
2. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 2008
3. John M. Yarbrough, Digital Logic, Application & Design, Thomson, 2010
4. Charles H. Roth, Fundamentals Logic Design, Jaico Publishing, 2009
5. John F. Wakerly, Digital Design Principles and Practices, Pearson Education, 2009

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2						2								6								10		20
2		2			2						12			2							4				20
3		2				2				8					8										20
4			2		2										12							4			20
5		2				2					12			4											20
																								Total	100

Assessment Questions
Remember

1. Define Flip-flop
2. List the various methods used for triggering flip-flops
3. List the procedural steps for designing asynchronous sequential circuit.
4. Define an up-counter and down-counter.
5. Define programmable logic array.
6. List out the basic types of programmable logic devices.
7. List out the characteristics of digital logics family.
8. Define Binary logic.
9. State the De-Morgan's theorem.
10. List out the various types of flipflops.

Understand

1. Draw the logic diagram for carry Look ahead adder.
2. Draw the characteristic table of JK Flip-Flop
3. Write the characteristic equation for the J-K flip-flop
4. Distinguish between combinational and sequential logic circuits.
5. Extrapolate the excitation table for S-R flip-flop
6. Differentiate Mealy Circuit and Moore Circuit.
7. Identify the major advantages of ECL Logic.
8. Indicate any two applications of open collector logic.
9. Compare static 0 and static 1 hazard.
10. Compare up-counter and down-counter.

Apply

1. Convert an SR flip-flop into D flip-flop.
2. Using SR flip flops, design a parallel counter which counts in the sequence 000,111,101,110,001,010,000…………
3. Design a counter with the following repeated binary sequence: 0,1,2,3,4,5,6. Use JK flip-flops.
4. Show how to minimize the number of rows in the primitive state table of an incompletely specified sequential machine?
5. Implement the switching functions:
   Z1 = ab’d’e + a’b’c’e’ + bc + deZ2 = a’c’e,
   Z3 = bc +de+c’d’e’+bdandZ4 = a’c’e +ce Using a 5*8*4 PLA
6. Sketch the operation of ECL with a neat diagram.

Analyse

1. Design the BCD-to-Seven Segment Decoder using minimum number of gates. The six invalid combinations should result in a blank display
2. Draw the circuit diagram of a T flip-flop derived from J-K flip-flop. Explain its operation
3. A synchronous sequential machine has a single control input x and the clock, and two outputs A and B. On Consecutive rising edges of the clock, the code on A and B changes from 00 to 01 to 10 to 11 and repeats itself if x = 1;if at any time, x = 0, it holds to the present state. Draw the state diagram and implement the circuit using T flip-flops.
4. Compare state diagram and state table.
5. A sequential circuit with 2D Flip-Flop A and B, input X and output Y is specified by the following next state and output equations.
   A (t+1) = AX+BX B (t+1) = XY = (A+B) X'
   (i) Draw the logic diagram of the circuit.
   (ii) Derive the state table.
   (iii) Derive the state diagram.
6. Differentiate PAL and PLA.
7. Compare SPLD and CPLD

Create

1. Design a combinational circuit with three inputs and one output. The output is 1 when binary value of the input is less than 3.
2. Tabulate the truth table and Implement the following Boolean functions by using 8*4 ROM
   (i) A(x,y,z) = Σ(1,2,4,6)
   (ii) B(x,y,z) = Σ(0,1,6,7)

15EI307 FLUID MECHANICS AND APPLIED THERMODYNAMICS LABORATORY 0 0 2 1

Course Objectives

- Expertise in the various thermodynamic concepts and principles
- Reinforce and enhance the understanding the fundamentals of Fluid mechanics and Hydraulic machines
- Provide practice in making engineering judgments, estimates and assessing the reliability of your measurements, skills which are very important in all engineering disciplines

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Understand the thermodynamics concepts and principles to implement in the real Engineering field
2. Interpret flow rate and discharge level of pumps
3. Design simple fluid power circuits
4. Develop Hydraulic and Pneumatic circuits
5. Analysis velocity, speed & viscosity

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	2	1				1					1
2	2	1	2	2	1				1					1
3	3	2	2	1	1				1					1
4	3	2	2	2	2				1					2
5	2	2	3	2	1				1					2

1 **3 Hours**

EXPERIMENT 1
Valve Timing and Port Timing Diagrams

2 **3 Hours**

EXPERIMENT 2
Performance Test on 4-stroke Diesel Engine by varying the load condition

3 **6 Hours**

EXPERIMENT 3
Find out the Viscosity value of the given oil sample by using Red Wood Viscometer

4 **6 Hours**

EXPERIMENT 4
Find out the Flash Point and Fire Point Temperature of the given fuel samples

5 **3 Hours**

EXPERIMENT 5
Performance test on Multistage Reciprocating Air Compressor by varying the delivery pressure

6 **6 Hours**

EXPERIMENT 6

Determination of the Coefficient of discharge of given Orifice meter

7 **3 Hours**

EXPERIMENT 7

Analyze the performance of centrifugal pump by varying the discharge level of the water

8 **3 Hours**

EXPERIMENT 8

Performance test on Submergible pump by varying the discharge level of the water

9 **6 Hours**

EXPERIMENT 9

Design and testing of fluid power circuits to control
i)velocity
ii)direction and
iii) force of single and double acting

10 **6 Hours**

EXPERIMENT 10

Design of Hydraulic and Pneumatic circuits using simulation software

Total: 45 Hours

15EI308 ELECTRON DEVICES AND CIRCUITS LABORATORY 0 0 2 1

Course Objectives

- To illustrate the VI characteristics semi conductor devices.
- To determine the various parameters of solid state devices by experimentally.
- To analyze the application of solid state devices.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Understand the applications of semiconductor devices.
2. Analyze the parameters of BJT and FET.
3. Apply the concept of UJT and SCR for simple applications
4. Design an oscillator circuit using R,L,C components.
5. Design an amplifier circuit using Transistors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										2	
2	1	2	3										3	
3		2	3	1									2	
4		2	3	1									3	
5		1	3	2									3	

1 **6 Hours**

EXPERIMENT 1

Design a switch using PN junction diode

2 **3 Hours**

EXPERIMENT 2

Design a voltage regulator using Zener diode.

3 **6 Hours**

EXPERIMENT 3

Determine h-parameters for a transistor under CE configuration.

4 **3 Hours**

EXPERIMENT 4

Determine transcondutance and transresistance of JFET.

5 **3 Hours**

EXPERIMENT 5

Design an intruder alarm circuit using UJT.

6 **6 Hours**

EXPERIMENT 6

Design a fan regulator using SCR.

7 **6 Hours**

EXPERIMENT 7

Design of audio frequency oscillator.

8 **6 Hours**

EXPERIMENT 8

Design of radio frequency oscillator.

9 **6 Hours**

EXPERIMENT 9

Design of instrumentation amplifier.

Total: 45 Hours

Reference(s)

1. Jacob. Millman, Christos C. Halkias and Sathyabrata Jit, Electronic Devices and Circuits, Third Edition, Tata McGraw Hill, New Delhi, 2011
2. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory, Tenth edition, Pearson Education, 2012
3. Theodre F. Boghert, Electronic Devices & Circuits, Sixth edition, Pearson Education, 2011

15EI309 MINI PROJECT I 0 0 2 1

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies, and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	1	2	2	3	3	2	3	3	3	3
2	2	2	3	2	3	1	2	3	3	1	3	3	3	3
3	2	2	3	2	3	1	2	2	3	1	2	3	3	3
4	2	2	3	2	3	3	2	3	3	3	3	3	3	3
5	2	2	3	1	3	1	2	2	3	3	2	3	3	3

15GE310 LIFE SKILLS: BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command in both the receptive skills (Listening and Reading)and the productive skills(Writing and Speaking) of English language
- Employ various types of sentences in business correspondence
- To acquire language skills needed for B2 level of the CEFR/ Common European Framework of Reference for Languages

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. The Students will be able to Listen to business conversations and understand specific information and overall idea
2. Read and understand business texts
3. Write coherent business letters, e-mails and reports using appropriate sentence structures and cohesive devices
4. Communicate orally in business situations using necessary verbal and non verbal devices
5. Appear for the Business English Certificate (BEC)Vantage level examination conducted by Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										3				
3										3				
4										3				
5										3				

1 **15 Hours**

UNIT I LISTENING AND READING

Listening for writing short answers - filling gaps in Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information - Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

2 **15 Hours**

UNIT II WRITING AND SPEAKING

Business Emails - notes - memos to colleagues or friends - Giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading Turn-taking - sustaining interaction - initiating - responding - giving personal information - Talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self-Study Practice Tests with Key, Heinle,a part of Cengage Learning, Delhi, 2003.

15MA401 NUMERICAL METHODS AND STATISTICS 2 2 0 3

Course Objectives

- By enrolling and studying this course the students will be able to understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically
- Summarize and apply the methodologies involved in solving problems related to ordinary and partial differential equations
- Apply the concepts testing of hypothesis in their core areas
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

1. Classify the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically
2. Demonstrate and obtain the differentiation and integration of functions using the numerical techniques
3. Obtain the solutions of all types of differential equations, numerically.
4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
5. Design an experiment for an appropriate situation using ANOVA technique.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	2													
3	3													
4	3													
5	3													

UNIT I **6 Hours**

SOLUTION OF EQUATIONS

Solution of algebraic and transcendental equations: Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigen values of a matrix by Power method.

UNIT II **5 Hours**

INTERPOLATION, DIFFERENTIATIONAND INTEGRATION

Interpolation: Newton's forward and backward interpolation formulae - Numerical differentiation: Newton's forward and backward interpolation formulae. Numerical integration: Trapezoidal rule-Simpson's rules for single integrals- Two point Gaussian quadrature formula.

UNIT III **7 Hours**

SOLUTIONS OF DIFFERENTIAL EQUATIONS

Solution of first order ordinary differential equations: Fourth order Runge- Kutta method - Solution of partial differential equations: Elliptic equations: Poisson’s equation- Parabolic equations by Crank Nicholson method- Hyperbolic equations by explicit finite difference method.

UNIT IV **6 Hours**

TESTING OF HYPOTHESIS

Sampling distributions- Large sample test: Tests for mean- Small sample tests: Tests for mean (t test), F-test- Chi-square test for Goodness of fit and Independence of attributes

UNIT V **6 Hours**

DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design.

FOR FURTHER READING

Collection of data and use the testing of hypothesis to analyze the characteristics of the data.

Total: 60 Hours

Reference(s)

1. Grewal B. S, Numerical Methods in Engineering and Science with Programms in C & C++, Ninth Edition, Khanna Publications, 2010.
2. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, PHI Learning Private Limited, New Delhi, 2009.
3. Gerald C. F and Wheatley P.O, Applied Numerical Analysis, Seventh Edition, Pearson Education, New Delhi, 2004.

4. Johnson R.A, Miller and Freund's Probability and Statistics for Engineers, Seventh Edition, Prentice Hall of India, New Delhi, 2005.
5. Walpole R.E, Myers R.H, Myers R.S.L and Ye K, Probability and Statistics for Engineers and Scientists, Seventh Edition, Pearsons Education, Delhi, 2002.
6. Burden R. L and Douglas Faires J, Numerical Analysis Theory and Applications, CengageLearning, Ninth Edition, 2005.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2					6					8			4			2								22
2		2									12								6						20
3	2					2				4					4				6						18
4	2						4			6				4					6						22
5		2					4				6				6										18
																								Total	100

Assessment Questions

Remember

1. Define Algebraic and Transcendental equations.
2. Write the formula for Regula False method & Newton's method.
3. What do you mean by Interpolation?
4. State Newton's Divided difference formula.
5. State the derivatives of Newton's Forward and Backward Interpolation formula.
6. Write the conditions for applying Trapezoidal & Simpson's rule.
7. What do you mean by Single step and Multi step method?
8. Write the formula for Euler's and Modified Euler's method.
9. What are the limitations of Graphical method?
10. Define Slack and Surplus variables.

Understand

1. What do you meant by Numerical methods?
2. What is the condition of convergence of Regula False position method?
3. State the order and condition of convergence of Newton's method
4. What are the methods for solving simultaneous algebraic equations?
5. Write the differences between Direct and Iterative methods.
6. State the sufficient condition for solving Gauss seidel method.
7. What do you mean by Power method?
8. Write Milne's and Adam's Predictor, Corrector formula.
9. What is feasible region?
10. Define Optimum basic feasible solution.

Apply

1. Obtain by power method, the numerically largest eigen value of the matrix $A = \begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$ with the starting vector $x^{(0)} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$.Perform only 4 – iterations.
2. Find $\sqrt{N}$, where N is a real number, by Newton's method.
3. 3. Find the parabola of the form $y=ax^2+bx+c$ passing through the points (0,0) , (1,1) & (2,20).
4. A third degree polynomial passes through (0,-1), (1,1),(2,1) & (3,-2) find its value at x=4.
5. Find the value of $f^{'}(8)$ from the table given below

$x:$	6	7	9	12
$f(x):$	1.556	1.690	1.908	2.158

6. 6. The table given below reveals the velocity V of a body during the time't' specified. Find its acceleration at t = 1.1

$t:$	1.0	1.1	1.2	1.3	1.4
$v:$	43.1	47.7	52.1	56.4	60.8

7. Solve $dy/dx=y^2-x^2 / y^2+x^2$ with y(0)=1 at x=0.2 find y .
8. Using Eulers's method, find y(0.01) from dy/dx= -x, y(0)=1.
9. Solve the following LPP: Maximize $Z = 4x_1 + 10x_2$
10. Subject to the constraints $2x_1+x_2 \leq 50$; $2x_1+5x_2 \leq 100$; $2x_1+3x_2 \leq 90$; $x_1, x_2 \geq 0$
11. Write down the four steps to be adopted in solving LPP.

Analyze / Evaluate

1. Using Newton's method, find the positive root of cos x = 3x - 1.
2. Solve by Gauss-Elimination method: 6x + 3y +12z = 36; 8x -3y +2z = 20; 4x +11y –z =33.

3. Use Lagrange's interpolation formula to find the value of x when y = 20 for the following data.

X :	1	2	3	4
Y :	1	8	27	64

4. By Newton's divided difference formula find f(301).

x	300	304	305	307
y	2.4771	2.4829	2.4843	2.4871

5. A rod is rotating in a plane. The following table gives the angle ‾ through which the rod has turned for various values of the time t secs

$t:$	0	0.2	0.4	0.6	0.8	1
‾ :	0	0.12	0.49	1.12	2.02	3.20

6. Evaluate $\int_{2}^{2.2}\int_{1}^{2.6} \frac{dydx}{x^2+y^2}$ using Trapezoidal formula.
7. Given $5xy' + y^2 - 2 = 0$; y(4)= 1; y(4.1) = 1.0049 find
   i) y (4.2) by Euler's method
   ii) y(4.3) by Runge-kutta method
   iii) y (4.4) by Adam's method.
   iv) y(4.5) by Milne's method.
8. Using Taylor series method, find the value of y(0.1) , given dy /dx = x + y and y(0)=1 and correct to 3 decimal places .
9. Solve the following LPP
   Maximize $z = 20x_1 + 80x_2$ subject to the constraints

$4x_1 + 6x_2 \le 90$; $8x_1 + 6x_2 \le 100$;

$5x_1 + 4x_2 \le 80$; $x_1, x_2 \ge 0$

10. Solve the following LPP graphically:

    Maximize $z = 100x_1 + 40x_2$ subject to the constraints

    $x_1 + 2x_2 \le 1000$; $3x_1 + 2x_2 \le 900$;

$x_1 + 2x_2 \le 500$; $x_1, x_2 \ge 0$

15EI402 DATA STRUCTURES 3 0 0 3

Course Objectives

- To learn the basics of abstract data types.
- To learn the principles of linear and non linear data structures
- To build an application using sorting and searching

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Understand the basics of data structures and algorithm analysis
2. Demonstrate the concept of linear data structures
3. Design of algorithms for various searching and sorting techniques
4. Demonstrate the concept of tree data structures
5. Express the concept of graph data structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	1	3	2											
3	2	3	1											
4	2	3	2											
5	2	3	2											

UNIT I **9 Hours**

INTRODUCTION

Pseudo code - Abstract data types - ADT Implementations -Algorithm efficiency - Designing recursive algorithms - Recursive examples

UNIT II **9 Hours**

STACKS, QUEUES AND LISTS

Arrays - Basic stack operation - Stack ADT - Applications of stack - Queues operations - Queue ADT - Queue applications - List ADT - Circular - Doubly linked list

UNIT III **9 Hours**

SORTING AND SEARCHING TECHNIQUES

Sorting: Insertion Sort - Selection Sort - Bubble Sort - Merge sort - Quick sort - Heap sort-shell sort - External Sorts Searching: Sequential search- Binary Search

UNIT IV **9 Hours**

TREES

Basic Tree concepts - Binary Trees - Tree Traversals - Expression tree - Binary Search Trees - AVL Search Trees - Heap concepts - Implementation - Heap ADT.

UNIT V **9 Hours**

GRAPHS

Definitions - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra's Algorithm. Minimum Spanning Tree: Prim's Algorithm - Kruskal's Algorithm

FOR FURTHER READING

Applications of list - Radix sort - B-Trees - Red-Black trees - Splay trees- Bucket hashing - Heap Applications: Priority Queue - Binomial Heaps - Topological sort - Introduction to NP Completeness

Total: 45 Hours

Reference(s)

1. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011
2. M.A.Weiss, Data Structures and Algorithm Analysis in C, Pearson Education Asia, 2013
3. Y.Langsam, M.J.Augenstein and A.M.Tenenbaum, Data Structures using C, PHI, 2007
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010
5. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2009

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2						2								6								10		20
2		2									12			2							4				20
3		2				2				8					8										20
4			2		2										12							4			20
5		2				2					12			4											20
																								Total	100

Assessment Questions

Remember

1. Define data structure.
2. Recall non-linear data structure.
3. Define stack.
4. List the basic operations of stack and queue.
5. Label the five types of sorting algorithms.
6. Define graph.
7. Recall the concept of searching.
8. Define minimum spanning tree.
9. List any five applications of tree data-structure.
10. Retrieve the concept of Heap.

Understand

1. Compare recursive algorithms and non-recursive algorithms.
2. Identify the minimum number of queues needed to implement the priority queue.
3. Interpret a class definition that could be used to define a node in a doubly linked list. Include only the instance variables, not the methods. Also write one sentence to describe a situation when a doubly linked list is appropriate.
4. Interpret Quick Sort for the following input: 65 70 75 80 85 60 55 50 45.
5. Exemplify the time complexity of sorting and searching algorithms.
6. Identify the suitable data structure for constructing a tree.
7. Indicate the condition for balancing an AVL tree.
8. Explain Djikstra‘s algorithm to find the shortest distance in a unweighted graph.
9. Illustrate ADT implementation of array.
10. Explain the Kruskal‘s Algorithm with an example.

Apply

1. Demonstrate Djikstra‘s algorithm to find the shortest distance in a weighted graph.
2. Construct the infix, prefix and postfix notations for the expression (a+b)*c/d-e
3. Find a situation where storing items in an array is clearly better than storing items on a linked list.
4. Predict the Hashing Functions based on the methods by which the key value is found.
5. Demonstarte the steps to insert a new item at the head of a linked list.
6. Use Binary Search algorithm with suitable example.
7. Show the recursive algorithm with an example.
8. Predict the shortest distance between any two specific node by using spanning tree.
9. Show the complexity of insertion sort.
10. Design an algorithm for bucket sort.

Analyse

1. Differentiate linear and non linear data structure.
2. Contrast ADT implementation of array and linked list.
3. Compare internal and external sorting.
4. Differentiate between binary tree and binary search tree.
5. Compare linear and binary search.
6. Differentiate DFS and BFS.
7. Outline the traversal with an example.
8. Justify whether linked list is linear or non-linear data structure.

Evaluate

1. Criticise the best case and worst case complexity for searching algorithms.
2. Judge whether stack can be used to perform queue operations.

Create

1. Produce an application using a stack /Queue /List /Tree that reflects a real world problem
2. Plan a suitable sorting technique for sorting the records of students in an educational institution.
3. Derive a sub algorithm to find a smallest element in an array

15EI403 ELECTRICAL AND ELECTRONICS MEASUREMENTS

2 0 2 3

Course Objectives

- To understand the construction and working of meters used for measurement of current, voltage, power and energy
- To acquire the concepts of the potentiometers and instrument transformers
- To gain knowledge about resistance, inductance and capacitance measuring methods and display/recording devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Outline the construction and working principle of measuring instrument to measure voltage and current
2. Examine the working principle of different watt meters and energy meters.
3. Comparethedifferenttypesofpotentiometersandinstrumenttransformers
4. Apply the various bridge techniques for the measurement of resistance and impedance in AC and DC circuits
5. Identify the appropriate display and recording devices and analyze the measurement of current, voltage and frequency using CRO

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											1	
2	3	2											1	
3	3	2											1	
4	2	3											2	
5	3	1	1										1	

UNIT I **5 Hours**

MEASUREMENT OF VOLTAGE AND CURRENT

Types of ammeters and voltmeters - Construction and working principle of PMMC Instrument, Moving iron Instrument, Dynamometer type Instrument and Rectifier type Instrument.

UNIT II **6 Hours**

MEASUREMENT OF POWER AND ENERGY

Construction and working principle of Electrodynamometer wattmeter and LPF wattmeter - Phantom loading - Measurement of power in three phase circuits - three phase wattmeters - Construction and working principle of single phase energy meter - Calibration of wattmeter, energy meter.

UNIT III **7 Hours**

POTENTIOMETERS AND INSTRUMENT TRANSFORMERS

Potentiometers: Construction and working principle of Crompton's potentiometer, Precision potentiometer, polar and Co-ordinate types - Applications. Instruments Transformers: Construction and working principle of Current transformers and Potential Transformers.

UNIT IV **6 Hours**

MEASUREMENT OF RESISTANCE AND IMPEDANCE

DC Bridges- Wheatstone bridge, Kelvin double bridge and Direct deflection methods - AC bridges - Maxwell, Wien's bridge, Hay's bridge and Anderson's bridge- Maxwell's inductance-capacitance bridge - De Sauty's bridge, and Schering bridge - Measurement of relative permittivity - Heaviside mutual inductance bridge - Megger.

UNIT V **6 Hours**

DISPLAY AND RECORDING DEVICES

Cathode ray oscilloscope - Time base generator - Basic CRO circuits - measurement of voltage, current, frequency and phase angle - Digital storage oscilloscope - Seven segment and dot matrix displays - Magnetic tap and disc recorders/reproduces - Protection and grounding circuits.

FOR FURTHER READING

Digital voltmeter: Integrating type, staircase ramp type, 3.5 digit display, resolution and sensitivity of digital meters - Digital multimeter - digital frequency meter - Digital measurement of time.

1 **2 Hours**

EXPERIMENT 1

Current and voltage measurement using PMMC instrument.

2 **3 Hours**

EXPERIMENT 2

Power measurement using wattmeter.

3 **3 Hours**

EXPERIMENT 3

Energy measurement using single phase energy meter.

4 **2 Hours**

EXPERIMENT 4

Voltage measurement using potential transformer.

5 **2 Hours**

EXPERIMENT 5

Current measurement using current transformer.

6 **2 Hours**

EXPERIMENT 6

Testing of Attenuation circuit using potential meter.

7 **4 Hours**

EXPERIMENT 7

Resistance measurement using Wheatstone bridge.

8 **4 Hours**

EXPERIMENT 8

Measurement of capacitance using Schering bridge.

9 **4 Hours**

EXPERIMENT 9

Measurement of voltage, current and frequency using CRO.

10 **4 Hours**

EXPERIMENT 10

Measurement of current using digital panel meter.

Total: 60 Hours

Reference(s)

1. A. K. Sawhney, Puneet Sawhney, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Company, 2014.
2. Ernest O.Doebelin, Dhanesh N Manik, Measurement systems, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2011.
3. J. B. Gupta, A Course in Electronic and Electrical Measurements and Instrumentation, S.K. Kataria & Sons, Delhi, 2013.

4. H. S. Kalsi, Electronic Instrumentation, Tata McGraw Hill company, New Delhi, 2010.
5. Reissland,U. Martin, Electrical Measurements: Fundamentals, Concepts, Applications, New Age International (P) Ltd., 2012.
6. E. W. Golding and F. C. Widdis, Electrical Measurements & Measuring Instruments, Reem Publications (P) Ltd, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6					8			4			2								22
2	2					4				4					4				6						20
3		2									10								6						18
4	2						4				6				6										18
5	2						4			6				4					6						22
																								Total	100

Assessment Questions
Remember

1. Recall the operating forces present in an analog instrument.
2. List the four different types of instrument used for making ammeter and voltmeter.
3. Define transfer instrument.
4. List the main source of errors in PMMC instruments.
5. State the Blondel‘s theorem.
6. State the benefits of fictitious loading.
7. State the benefits of fictitious loading.
8. Define the term calibration.
9. State the burden of a current transformer.
10. List two methods for testing current transformers.
11. Recall four errors caused in potential transformer.
12. List four applications of instrument transformers.
13. Recall two methods used for the measurement of capacitance.
14. Label two applications of Wien‘s bridge.
15. Define chassis ground.
16. Recall four merits of the digital oscilloscope.
17. Define working current of a potentiometer.
18. Recall four materials used to fabricate light emitting diode.
19. Illustrate the principle of an induction type energy meter and obtain an expression for its deflecting torque.

Understand

1. Classifythe two types of moving iron instrument.
2. Indicate the ammeter and voltmeter connection in a circuit.
3. Illustrate the constructions and working principles of moving coil and moving iron instruments
4. Summarize the construction and working of dynamometer and rectifier type instruments
5. Formulate the steps to obtain the expression for steady state deflection of a moving iron instrument.
6. Indicate the need for LPF wattmeter in power measurement.
7. Explain the construction and working principle of the single-phase energy meter.

8. Summarize the steps to obtain sensitivity of a Wheatstone bridge in terms of voltage and current sensitivity of the galvanometer.
9. Indicate the steps to standardize a potentiometer
10. Indicate the current and voltage measurement process with the help of instrument transformers.
11. Identify the effects of ratio and phase angle errors in case of a C.T.
12. Summarize the relationship between primary and secondary winding voltage of a Potential Transformer.
13. Formulate expression for unknown frequency using a Wien's bridge.
14. Infer the conditions that must be satisfied to balance an AC bridge.
15. Explain the procedure to measure an unknown voltage using polar and coordinate type AC potentiometers.
16. Identify a technique to protect the instrument from overloading and short circuit conditions.
17. Indicate the operation of vertical and horizontal amplifiers used in CRO.
18. Indicate the specialities of a storage Oscilloscope.
19. Explain the operation of the time base generator with a circuit and waveform.
20. Identify the conditions to be satisfied by the device for emitting visible light.
21. Indicate the steps to measure voltage and phase angle between two voltages using CRO.

Apply

1. Predict the role of volt-ratio box.
2. Predict the steps to obtain expressions for steady state deflection of a moving coil and electrodynamometer type instruments.
3. Show the connection diagrams for measuring voltage and power using electrodynamometer type instrument.
4. Implement Blondel's theorem for measuring power at 3 phase 3 wire systems and explain its operation
5. A 3 phase 500 V motor load has a power factor of 0.5 and two wattmeters are connected to measure the input power. If the measured power is 30kW, predict the reading of each wattmeter.
6. A wattmeter has a current coil of 0.03 ohm resistance and a pressure coil of 6000 ohm resistance. Compute the percentage error, if the wattmeter current coil connected at i) load side and ii) supply side.
7. Construct a circuit to reduce the power consumption while testing an energy meter and explain its operation.
8. Use a potentiometer to calibrate wattmeter and show the calibration steps.
9. Use a potentiometer to calibrate a wattmeter and show the calibration steps.
10. Assess a proper connection diagram in the secondary of a current transformer to safely measure the high current using low range ammeters.
11. Show that the resistance of leads does not affect the result in Kelvin's bridge by connecting the galvanometer at a particular position
12. A Kelvin bridge is balanced with the following constants: outer ratio arm 100Ω and 1000Ω; Inner arm ratio 99.92Ω and 1000.6Ω; Resistance of link 0.1Ω; standard resistance of 0.00377Ω. Find the value of Unknown resistance.
13. In a Maxwell's bridge the fixed component values are R2=400Ω, R3=600Ω, R4=1kΩ C4=0.5µF. Compute the appropriate values for remaining components to balance the bridge.
14. In an Anderson Bridge the component values under balanced conditions are given below. Compute the unknown inductance L1 and resistance R1. R4 = R2 =600Ω, r=400Ω, R3=800Ω, r=0Ω and C=1µF.
15. Use a potentiometer circuit and 0.186V standard emf cell to measure an unknown voltage (between 0 and 1V). Assume suitable dial resistances. Explain the voltage measurement process using the circuit.

16. A CRO is set to a time base of 0.1ms/cm with a 10 cm amplitude. Predict the pulse signal waveform with pulse repetition rate of 2000Hz and a duty cycle of 25%.
17. Construct a 5x4 dot matrix display and explain its operation.

Analyse

1. Compare Moving coil and Moving Iron Instrument.
2. Compare the operation of various instruments used for measuring voltage and current.
3. Outline the major conclusions about AC bridges by analyzing the balance equations.
4. Differentiate between the direct and phantom loading methods and judge the most suitable one for testing energy meter.
5. Contrast the current coil and voltage coil connection in induction type energy meter.
6. ‘Phantom loading is used to save the power’ – Justify the statement with an example.
7. Compare the operation of different type of bridge circuits.
8. Contrast analog and digital storage oscilloscopes.
9. Compare seven segments and dot matrix displays.
10. Differentiate between current transformer and potential transformers.
11. Differentiate between nominal and turns ratio of instrument transformers.

Evaluate

1. Choose a circuit connection to protect the human being from electrical shock while handling electrical appliances
2. Judge the effect of power factor on wattmeter readings
3. Judge the effect of two variable elements in one balance equation
4. In the Wheatstone, value of the various arm resistance is given by P= 1kΩ, Q=100Ω, R=2005Ω and S= 200Ω. The battery has an emf of 5V and negligible internal resistance. The galvanometer has the current sensitivity of 10 mm/µA and an internal resistance of 100Ω. Determine the deflection of galvanometer and the sensitivity of the bridge
5. In an Anderson Bridge for the measurement of inductance the arm AB consists of an unknown impedanceÂ with inductance L and R, a known variable resistance in arm BC, fixed resistance or 600Ω each in arms CD a DA, a known variable resistance in arm DE, and a capacitor with fixed capacitance of 1 microfarad in the arm CE. The a.c. Supply of 100Hz is connected across A and C, and the detector is connected between B and E. If the balance is obtained with a resistance of 400Ω in the arm DE and a resistance of 800Ω in the arm BC, Determine the value of unknown R and L.
6. Construct a bridge circuit with the component values of C2=500pF, R3=300Ω, R4=72.6Ω C4=0.148µF to measure unknown capacitance and choose appropriate values for C1 and r1 to balance the bridge. (Assume:R4 and C4 are in parallel).
7. Judge the reasons for dividing fixed coil into two parts in electrodynamometer instruments.
8. A CRO with a sensitivity of 5v/cm is used. An AC voltage is applied to the Y-input. A 10cm long straight line is observed. Determine the AC voltage.
9. Judge the maximum and minimum values that can be displayed using a 3½ display.

Create

1. Derive a bridge circuit to employ in a harmonic distortion analyzer for discriminating 1 kHz frequency. Assume R1 = 1 kΩ, R2 = 2 kΩ, and C1 = 0.1 µF.
2. Produce a circuit to measure current using CRO and explain its operation.
3. Derive a circuit to convert the change in temperature in voltage by assuming suitable resistance values and explain its operation. Let the primary sensing element is RTD.

15EI404 COMMUNICATION ENGINEERING 2 0 2 3

Course Objectives

- To understand the fundamental concepts of communication systems.
- To analyze different analog and digital modulation schemes
- To familiarize the basic concept of telephone modems and Optical Fiber Communications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Illustrate the concept of amplitude modulation in time and frequency domain
2. Apply angle and phase modulation technique to design FM transmitter and receiver
3. Analyze different types of modulation techniques in digital communication system using time and frequency division multiplexing
4. Identify appropriate telephone and cable modem architecture for digital data transmission.
5. Apply wavelength division multiplexing concept to develop fiber optic communication system for telephone and television applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										3	
2	3	2	3										3	
3	1	3	1											
4	2	3	1											
5	3	2	3										3	

UNIT I **9 Hours**

AMPLITUDE MODULATION

Elements of communication systems, Time and frequency domain, Noise and communications, Amplitude modulation, introduction, full carrier AM in time domain and frequency domain, Quadrature AM and AM stereo, suppressed-carrier AM,AM Transmitters, AM Receivers.

UNIT II **9 Hours**

ANGLE MODULTION

Angle modulation, Phase modulation, Angle modulation spectrum, FM and Noise, FM stereo, FM measurements, FM Transmitters, FM Receivers, Receivers topologies, FM Demodulators

UNIT III **9 Hours**

DIGITAL COMMUNICATION

Introduction, Pulse Modulation, Pulse code modulation, Delta Modulation, Line codes, Time division multiplexing, vocoders and Data Compression, Digital modulation-Introduction, Frequency and phase shift keying, Quadrature Amplitude Modulation

UNIT IV **9 Hours**

DATA TRANSMISSION AND MODEMS

Data coding, Asynchronous Transmission, Synchronous Transmission, Error detection and Correction, Data compression and encryption. Telephone Modems, Modem to computer connections, Cable Modems and Digital subscriber Lines.

UNIT V **9 Hours**

FIBER OPTIC SYSTEMS

Basic fiber optic systems, repeaters and optical amplifiers, wavelength division multiplexing, submarine cables, SONET, Fiber in local area networks, local telephone applications, cable television applications, experimental techniques, optical time-domain reflectometry.

FOR FURTHER READING

Local area networks, wide area networks, satellite communication, cellular communication.

1 **3 Hours**

EXPERIMENT 1

Amplitude Modulation and Demodulation

2 **3 Hours**

EXPERIMENT 2

Frequency Modulation and Demodulation

3 **3 Hours**

EXPERIMENT 3

Pulse Amplitude Modulation and Demodulation

4 **3 Hours**

EXPERIMENT

Pre-Emphasis and De-Emphasis circuits

5 **3 Hours**

EXPERIMENT

Digital Modulation: ASK,FSK

Total: 60 Hours

Reference(s)

1. Roy Blake, Electronic Communication Systems, Thomson Delmar Ltd, New York, 2013
2. Wayne Tomasi, Electronic Communication Systems, Pearson Education Asia Ltd, New Delhi, 2012

3. Louis Frenzel ,Principles of Electronic Communication Systems by 3rd Edition,TMH publications,2010.
4. Miller, Modern Electronic Communication, Prentice Hall of India, New Delhi, 2010
5. William Schweber, Electronic Communication System, Prentice Hall of India Ltd, India, New York, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	4				2	4				6				2				2							20
3	8				2					6				2	3										21
4		4			4					6				2	3				2						21
5		4				6				6				6											22
																								Total	100

Assessment Questions
Remember
1. Define critical frequency
2. List the applications of the quarter-wave line.
3. State Carson‘s rule of FM bandwidth.
4. Define modulation index of FM and PM.
5. List out the vocoding techniques.
6. State Quantization range and Quantization error.
7. Define Bit Error Rate (BER).
8. List the topologies used in data communication.
9. List out the classification of AMPS cellular telephones.
10. Define TDM.

Understand
1. Explain any two methods of generating DSB-SC.
2. Explain the collector modulation method for generating AM wave with a neat circuit diagram and waveforms.
3. Summarise the various ways in which a signal propagates through space.
4. Explain the collector modulation method for generating AM wave with a neat circuit diagram and waveforms.
5. Explain the high level AM transmitter with neat diagram.
6. Explain the working principle of the Digital T carrier system.
7. Formulate the functions of ISO-OSI seven layer architecture.

Apply
1. Assess how the error is detected and corrected using Hamming codes in data communication?
2. Show the equivalent circuit for a metallic two wire transmission line.
3. An 80 MHz carrier is having an amplitude of 50v is modulated by 3 KHz audio signal is having an amplitude of 20v. Implement the frequency spectrum of AM wave.
4. Demonstrate the expressions of the DSB-SC wave in time and frequency domain.
5. Select the suitable method for data transmission.

6. Compute the coding efficiency for the sample and hold circuit determine the minimum number of bits required in a PCM code for a dynamic range of 80dB.
7. Assess how will you calculate over modulation of AM?
8. Assess how the ultimate modulation index of FM is estimated?
9. Show the use of Numerical Aperture?
10. Show the purpose of sample and hold circuit?

Analyse

1. Differentiate Radian & Steradian.
2. Determine the transmit power for a CDMA mobile unit that is receiving a signal from the base station at 100dBm.
3. Compare different AM methods.
4. Contrast the advantage and disadvantages of digital transmission.
5. Compare PCM and DM.

Evaluate

1. Determine the number of cells in clusters for the following values: j=4 and i=2 and j=3 and i=3.
2. A PCM-TDM system multiplexes 32 voice-band channels each with a bandwidth of 0 kHz to 4 kHz. Each sample is encoded with an 8-bit PCM code. UPNRZ encoding is used. Determine Minimum sample rate, Line speed in bits per second and Minimum Nyquist bandwidth.
3. Determine the Nyquist sampling rate for the following maximum analog input frequencies: 2 kHz, 5 kHz, and 20 kHz.
4. A transmitter has a power of 50 mW to a 50 Ω transmission line. The transmission line impedance is not equal to the characteristic impedance of the transmission line. The coefficient of reflection is 0.5. Determine the reflected power and dissipated power.

Create

1. Generate a procedure to find the AM & FM spectrum by using spectrum analyzer.
2. Derive an expression for signal to noise ratio in angle modulated system.
3. Derive Campbell‘s equation.

15EI405 TRANSDUCERS ENGINEERING 3 0 0 3

Course Objectives

- To understand the concepts of calibration, characteristics and response of transducers
- To impart knowledge in the construction and characteristics of various electrical transducers
- To familiarize about different transducers and sensors

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Examine the type of errors, characteristics and mathematical model of a transducer.
2. Apply the characteristics of variable resistive transducer in a given application.
3. Analyze the principles of variable inductive transducer.
4. Characterize the different capacitive transducers for the measurement of physical quantities
5. Identify various transduction methods used for field applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										1	
2	2	3	2										3	
3	2	3	2										3	
4	2	3	2										3	
5	2	2	3										3	

UNIT I **9 Hours**

CHARACTERISTICS OF TRANSDUCERS

Units and Standards - Static calibration- Classification of errors -Error analysis -Limiting error -Probable error -Static characteristics-Accuracy, Precision, Resolution, sensitivity, Linearity, Hysteresis, Range and Span, Drift, Dead Zone- Mathematical model of transducers - zero, first and second order transducers - Dynamic characteristics of first and second order transducers for standard test signals.

UNIT II **9 Hours**

VARIABLE RESISTANCE TRANSDUCERS

Principles of operation - Construction details -Characteristics of resistance transducers -Resistance potentiometers -Strain gauges -Resistance thermometers -Thermistors - Thermocouples -Hot wire anemometer -Piezoresistive sensor and humidity sensor - Signal Conditioning Circuit for Thermistor and Thermocouple.

UNIT III **9 Hours**

VARIABLE INDUCTANCE TRANSDUCERS

Induction potentiometer -Variable reluctance transducers -Linear Variable Differential Transformer-LVDT Pressure transducer- Rotary Variable Differential Transformer-Eddy current transducers, synchros and resolvers -Electromagnetic sensors.

UNIT IV **9 Hours**

VARIABLE CAPACITIVE TRANSDUCERS

Variable air gap type - Variable area type - Variable permittivity type - Feedback type capacitance proximity pickup - Capacitor micro phone -Electrostatic transducer - Ultrasonic Sensors

UNIT V **9 Hours**

OTHER TRANSDUCERS

Piezoelectric transducer- Magnetostrictive transducer - Semiconductor sensor - Digital transducers - Smart sensors- Fiber optic transducers -Hall effect transducers -Photoelectric transducers-Introduction to MEMS, Nano sensors and Bio Sensor.

FOR FURTHER READING

Seismic Sensor - IC temperature sensor- Pneumatic transducer- Flapper-Nozzle sensor - Sensors for environmental monitoring-Sensing environmental pollution-Aerospace sensor- Sensing direction of air flow-Measuring air speed on air craft

Total: 45 Hours

Reference(s)

1. A. K. Sawhney, Puneet Sawhney, A course in Electrical and Electronic Measurements and Instrumentation, Nineteenth edition Dhanpat Rai & Co (P) Ltd, 2012.
2. E.O.Doeblin, Measurement Systems: Applications and Design , 6th Edition, Tata McGraw-Hill Book Co., 2012
3. D. V. S. Murthy,Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2013
4. J. P. Bentley, Principles of Measurement Systems, 4th Edition, Addison Wesley Longman Ltd., UK, 2015
5. D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, 2009

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4				4					4					4			2							18
2		2				4				4				6			2								18
3		2				6				6				2			4								20
4		6				6								6				4							22
5		4					6					6		4				2							22
																								Total	100

Assessment Questions

Remember

1. Define units.
2. Give the classification of units.
3. Define Standards.
4. Define Instrumental error.
5. State the principle of primary transducer.
6. What is active transducer?
7. Name any one analog transducer.
8. List the different static characteristics of a transducer.
9. Define dynamic characteristic.
10. Mention the different type‘s dynamic characteristics.
11. Define mathematical model.

12. What is potentiometer?
13. List out the advantages and disadvantages of potentiometer?
14. Recall the different types of strain gauge?
15. Mention the applications of strain gauge.
16. Define resistance thermometer.
17. What is self-heating error of thermometer?
18. Recall the principle of hotwire anemometer.
19. Identify the applications of thermistors.
20. State the principle of operation of piezo resistive sensor.
21. Define inductance transducer.
22. Mention the three principles of inductance transducer.
23. Recall the principle of variable reluctance accelerometer.
24. Point out the need for demodulator in variable reluctance accelerometer.
25. What is the principle of Induction Potentiometer?
26. Define LVDT.
27. State the applications of LVDT.
28. List the advantages and disadvantages of LVDT.
29. Memorize the principle of the electro-magnetic transducer.
30. Why transducers need a signal conditioning unit?
31. What is digital transducer?
32. State the principle of change of capacitance.
33. Describe the principle of capacitive transducer.
34. List the uses of capacitive transducer.
35. Define magnetostrictive transducer.
36. Name the different magnetostrictive transducers.
37. What are the errors in magnetostrictive transducer?
38. Select the suitable materials for piezo electric transducer.

Understand

1. Distinguish between accuracy and precision.
2. What are the different types of static errors? Explain each of them.
3. What are instrumental and environmental errors? How can they be avoided?
4. What is the difference between a primary and a secondary standard?
5. How self-heating error is corrected for in resistance thermometry?
6. For what application, thermistor is preferred as temperature sensor?
7. Distinguish between a resistance strain gauge and a semiconductor strain gauge.
8. Why piezoelectric transducers are useful only for dynamic measurement?
9. How frequency of supply changes the sensitivity of an LVDT?
10. Express how ―true zero‖ is obtained in an Induction potentiometer?
11. Give examples of capacitive transducer applications.
12. Demonstrate how a capacitive transducer used for measuring the displacement?
13. How capacitive transducer used to measure the sound signal?
14. Illustrate the principle of capacitive pressure transducer.
15. Show how slew rate affects the operation of analog to digital converter?
16. How to choose the specific type of A/D for the given application?
17. Compare digital transducer with analog.
18. Indicate the uses of fiber optic transducers.
19. Express the special features of magnetostrictive transducer.

20. In what way MEMS technology improves the efficiency of sensor?

Apply

1. A temperature transducer with a time constant of 0.4 sec and a static sensitivity of 0.05mV/ ºc is used to measure the temperature of a hot liquid medium which changes from 25ºC to 65ºC.The transducer is adjusted to read 0 and 25ºC.Determine the time taken to read 80% of the final voltage value if the temperature changes as a step.
2. Calculate the reading of the transducer at the end of 4 sec if the temperature changes at a constant rate of 10º per sec from 25ºC to 65ºC.Ten measurements of pressure made by an instrument at different time intervals give the following readings in kg / cm2: 7.29, 8.03, 8.10, 7.95, 8.01, 7.98, 7.95, 8.07, 7.94 and 7.97.Find arithmetic mean, standard deviation, and most probable error.
3. A variable potential divider has a total resistance of 2kΩ and is fed from a 10V d.c. supply. The output is connected to a load resistance of 5kΩ. Determine the loading errors for the wiper positions corresponding to K=xi /xt =0, 0.25, 0.5, 0.75, and 1.0. Use the result to plot a rough graph of error versus xi /xt.
4. The output of an LVDT is connected to a 5V voltmeter through an amplifier whose amplification factor is 250. An output of 2 mV appears across the terminals across the terminals of LVDT when the core moves through a distance of 0.5 mm. calculate the sensitivity of the LVDT and that of the whole set up. The milli-voltmeter scale has 100 divisions. The scale can be read to 1/5 of a division. Calculate the resolution of the instrument in mm.
5. A Hall effect transducer is used for the measurement of a magnitude field of 0.5 Wb/m2. The 2 mm thick slab is made of Bismuth for which the Hall‘s co-efficient is -1x10-6 V m/ (A – Wb m-2) and the current is 3A.
6. A parallel plate capacitive transducer has plates 600 mm2 area which is separated by air by a distance of 0.2mm. The resistance of the transducer is 20 X 106 Ω. Calculate the time constant of the transducer and find the attenuation of the output 1000 Hz. The permittivity of the air is 8.85 X 10-12 F/m.
7. A quartz crystal has the dimensions of 2 mm X 2 mm X 2 mm. Quartz has the following properties charge sensitivity = 21 C/N. Young‘s modulus = 8.6 X 1010 N/m2. Permittivity = 40.6 X 10-12 F/m. Calculate the value of force, charge, and voltage if the crystal is subjected to a strain of 10 X 10-6 m/m.
8. A thermistor has a resistance of 10KΩ at 25C. The resistance temperature co-efficient is -0.05/°C. A Wien‘s bridge oscillator uses two identical thermistors in the frequency determining part of the bridge. The value of capacitance used in the bridge is 500 pF.

Analyze / Evaluate

1. Compare Zero order, First order and second order transducer.
2. Compare RTD, Thermocouple and Thermistor.
3. Compare different types of Analog to digital converter.

Create

1. Design a signal conditioning circuit for LVDT. The output current from the signal conditioning circuit should be in the range 4 – 20 mA.

15EI406 LINEAR INTEGRATED CIRCUITS 3 2 0 4

Course Objectives

- To understand the procedure realize circuits, study the chracteristics and signal analysis using Op-amp ICs
- To study the application of Op-amp
- To study internal functional blocks and the application of special IC's like Timers, PLL circuits, regulator circuits, ADCs

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Identify the steps involved in fabricating an IC and to discuss the characteristics of Op-amp
2. Construct a simple application circuit using an Op-amp.
3. Design a simple filter circuit using Op-amps and differentiate A/D and D/A conversion techniques.
4. Examine the various special ICs used for field applications.
5. Characterize the different types of regulators and amplifiers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2										1	
2	1	1	3	2									3	
3	1	2	3	1									3	
4	3	1	2										1	
5	3	1	2										1	

UNIT I **7 Hours**

IC FABRICATION

IC classification, fundamentals of monolithic IC technology, epitaxial growth, masking and etching, Diffusion of Impurities and packaging - methods of fabricating PN diode, PNP transistor, resistors, capacitors and inductor - Realization of simple monolithic ICs

UNIT II **9 Hours**

CHARACTERISTICS OF OP-AMP

Ideal Op-Amp characteristics - voltage series feedback and shunt feedback amplifiers - DC characteristics, AC characteristics: frequency response, frequency compensation and slew rate.

UNIT III **11 Hours**

APPLICATIONS OF OP-AMP

Differential Amplifier, Instrumentation amplifier, First order low pass and high pass filters, V/I & I/V converters, comparators, summer - Schmitt trigger, multivibrators, triangular and sine waveform generators, S/H circuit, D/A converter: R-2R ladder and weighted resistor types - A/D converter: Dual slope, successive approximation and flash types.

UNIT IV **9 Hours**

SPECIAL ICS

555 Timer circuit: monostable operation, astable operation and applications - 566-voltage controlled oscillator circuit - 565-phase locked loop circuit functioning and applications - Analog Multiplier ICs.

UNIT V **9 Hours**

APPLICATION ICS

IC voltage regulators: 78XX-Fixed and LM317-adjustable voltage regulators, LM723 general purpose regulators, Basic and UA78S40-step down switching regulators - LM380 power amplifier, Isolation Amplifiers, Optocoupler and applications.

FOR FURTHER READING

Second order low pass and high pass filters - differentiator and integrator - clippers, clampers and peak detector, ICL 8038 function generator IC.

Total: 75 Hours

Reference(s)

1. Robert F. Coughlin, Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th Edition, Pearson Education, 2015.
2. Roy Choudhary, Shail B. Jain, Linear Integrated Circuits, New Age Publishing Co, 4th Edition, 2014.
3. Ramakant A. Gayakwad, Op-amps and Linear Integrated Circuits, Prentice Hall, 4th Edition, 2009.
4. William D. Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, 4th Edition, 2002.
5. R. M. Marston, Optoelectronics Circuits Manual, Newnes, 2nd Edition, 1999.
6. Anthony Peyton, Vincent Walsh, Analog Electronics with Op-amps: A Source Book of Practical Circuits, Cambridge University Press, 1993

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	6					6	6								4										22
2	3	2	2				4			4									2				2		19
3	2	3				2				4				4					4				2		20
4	4	2	2				4				4								2						19
5	2	2	2			4	4				4				2										20
																								Total	100

Assessment Questions
Remember

1. State the various IC packaging techniques.
2. Define the term diffusion.
3. Define the term Epitaxial layer.
4. List the two different IC technologies.
5. Define buck boost regulator.
6. List the advantages of integrated circuits over discrete component circuits.
7. Define an operational amplifier.
8. List the characteristics of an ideal op-amp.
9. Recall the advantages of integrated circuits.
10. Define input offset voltage.
11. List the applications of Hall effect ICs.
12. Define input offset current.
13. State the reasons for the offset currents at the input of the op-amp.
14. Define CMRR of an op-amp.
15. Define sensitivity.
16. List the frequency compensation methods.
17. Label the merits and demerits of Dominant-pole compensation.
18. Define slew rate.
19. List some of the linear and non – linear applications of op-amps.
20. List the features of the instrumentation amplifier.
21. Reproduce applications of the V-I converter.
22. Define comparator.
23. Recall the applications of comparator
24. Define multivibrator.
25. State the requirements for producing sustained oscillations in feedback circuits.
26. Name any two audio frequency oscillators.
27. Reproduce the characteristics of a comparator?
28. Define filter.
29. Recall the merits and demerits of both active and passive filters?
30. List some commonly used active filters.
31. Recall the advantages of integrating type ADCs.
32. List the design considerations of single supply op amp.
33. Define resolution of a data converter.
34. State the main drawback of a dual-slope ADC?
35. List the direct type ADCs.
36. State the advantages of dual slope ADC.
37. Define conversion time.
38. Define accuracy of converter.

39. State the applications of PLL
40. List the basic building blocks of PLL.
41. Define lock-in range of a PLL.
42. Define capture range of the PLL.
43. Define Pull-in time.
44. State the expression for the VCO free running frequency.
45. Define Voltage to Frequency conversion factor.
46. List the applications of 555 timers in the monostable and astable mode of operations.
47. Recall the wave pattern to express lock-in range and capture range.
48. Define Hall effect IC.
49. List any two applications of LM380 power amplifier
50. Recall four features of µA78S40 switching regulators
51. Reproduce the pin configuration of IC741.
52. Define the sample period and hold period.
53. Recall the functional block diagram of a 723 regulator.
54. List the features of buck boost regulator.

Understand

1. Classify the Integrated Circuits.
2. Indicate the steps to prepare silicon wafer
3. Explain the Czochralski growth (CZ) process and wafer processing steps with diagram and expressions.
4. Explain the oxidation process and its importance in IC fabrication technology with a suitable equation.
5. Illustrate the photolithography process with suitable diagrams.
6. Illustrate the Ion implantation process used in IC manufacturing.
7. Indicate the purpose of oxidation.
8. Represent the various processes used to fabricate IC‘s using silicon planar technology.
9. Summarize the process steps used in the fabrication of ICs using silicon planar technology
10. Illustrate the steps to obtain the expressions for common mode and differential mode gains of a differential amplifier.
11. Differentiate between input bias current and input offset current.
12. Distinguish between common mode and differential mode signals.
13. Infer the causes of slew rate?
14. Classify DC characteristics of an op-amp and explain the procedure to improve the characteristics
15. Indicate the need for frequency compensation in practical op-amps.
16. Explain the need for an instrumentation amplifier? Give a detailed analysis for the same.
17. Compare State Schmitt trigger and astable circuit.
18. Indicate the requirements for producing sustained oscillations in feedback circuits.
19. Explain any two audio frequency oscillators.
20. Indicate the drawbacks of weighted resistor type digital to analog converter.
21. Classify and Explain the types of DACs
22. Explain the working principle of phase locked loop.
23. Formulate the expression for Lock range and capture range.
24. Classify the types of low drop out regulators.
25. Indicate the purpose of having a low pass filter in PLL.
26. Interpret the effects of having a large capture range.
27. Illustrate the procedure to generate triangular wave using ICL 8038.
28. Explain the operation of VCO and formulate an expression for f_o.
29. Give some examples of monolithic IC voltage regulators.
30. Give the drawbacks of linear regulators.
31. Indicate the steps to achieve current boosting in IC 723 general purpose regulator.
32. Express the operation LM380 based audio power amplifier.

Apply

1. Predict the role of SiO_2 in IC manufacturing
2. A non-inverting amplifier has an input resistance R_1=1 kΩ, feedback resistance R_f = 10kΩ, input offset voltage V_{ios} = 5 mV and offset current I_{os}= 10nA. Compute (i) Maximum output offset voltage due to V_{ios}, (ii) Compensating resistance R_{comp}, (iii) Maximum output offset voltage, after connecting compensation resistor. (iv) Closed loop gain.
3. A non-inverting amplifier has an input resistance R_1=10 kΩ, feedback resistance R_f = 15 kΩ, input voltage v_i = 1.5 V and load resistance R_L = 20 kΩ. Find (i) output voltage, (ii) Closed loop gain, (iii) current through the resistance R_1. (iv) Repeat the problem for inverting amplifier.
4. Select suitable steps to overcome the effect of input bias current of the op-amp output voltage
5. Show that the output corresponds to the common mode voltage $v_{cm} = (v_1+v_2)/2 = 0$ if $R_3/R = R_2/R_1$ by considering a differential amplifier with ideal op-amp (Shown in the figure)
6. Choose an op-amp configuration to get 180^o phase shifted output.
7. Predict the output of 555-timer based monostable multivibrator, when the voltage across the capacitor is more than $(2/3)V_{cc}$.
8. Predict the output waveform of an open loop comparator, when its inverting terminal is connected to ground potential and non-inverting terminal is connected with $1V_{pp}$ sinusoidal signal
9. Select an op-amp circuit to convert the square wave into triangular wave and explain its operation.
10. Examine the principle of operation of the successive Approximation ADC.
11. Predict the parameter, which alters the free running frequency of the VCO.
12. Consider VCO with V_{cc}= 10V, V_c= 3V, R_T=10kΩ, C_T=0.1µF, compute the output frequency.
13. Use PLL to translate frequency and demonstrate its operation with suitable block diagram
14. Classify the different types of phase detector.
15. Implement PLL to translate frequency and predict its operation with suitable block diagram
16. Predict the steps to design a step-down voltage regulator using µA 78S40 switching regulator IC.
17. Construct a signal isolation circuit and demonstrate its operation.
18. Predict the role of opto-couplers in instrumentation.
19. Discover the classification of voltage regulators.

Analyse

1. Compare dry and wet etching process.
2. Identify role of each layer in the IC
3. "The gain is stabilized by negative feedback"-justify.
4. Conclude the effect of high frequency in the performance of a practical op-amp.
5. Indicate the steps to obtain the input impedance from the voltage shunt feedback configuration
6. Identify the reason to get gain roll-off in op-amp circuits after a certain frequency.
7. Identify the need for external frequency compensation in op-amp.
8. Compare negative and positive feedback
9. Choose an op-amp configuration to get attenuated output.
10. Differentiate astable and monostable multivibrator.
11. Select a suitable resistance value to get cutoff frequency of 5kHz from an op-amp based low pass filter. Assume: Capacitance = 0.01µF.
12. Differentiate Schmitt trigger and comparator.
13. Compare the 555-timer based monostable and astable operations.
14. Determine the expression for voltage to frequency conversion factor in VCO.
15. Conclude the requirement of current limit protection and current foldback techniques in IC723 general purpose regulator.

Evaluate

1. Judge the steps to fabricate the following circuit.
2. Differentiate between the open loop and closed loop gain of the op-amp.
3. Differentiate between common mode and differential mode signals
4. Judge the output waveforms of voltage follower and inverter circuits when their input is 2V DC
5. A non-inverting amplifier has an input resistance R_1=1 kΩ, feedback resistance R_f = 100 kΩ, $\Delta V_{ios}/\Delta T$ = 30 µV/^oC and $\Delta I_{os}/\Delta T$ = 0.3 nA/ ^oC. Assume the op-amp is nulled at 25^{o}C. Determine the output voltage and error voltage due to temperature, if (i) input voltage V_{in} = 1 mV DC and (ii) V_{in} = 5 mV DC.
6. An inverting amplifier with the T feedback network has an input resistance R_1=10 MΩ, Input impedance R_i = 10MΩ, Closed loop gain A_{CL} = -10 and resistance R_t = 20 kΩ (On T network right and left hand side resistance is called as R_t, and middle resistance is called as R_s). Determine (i) Feedback resistance and (ii) R_s.
7. Determine the frequency response of an open-loop op-amp and discuss about the methods of frequency compensation.
8. Determine the output voltage of the Adder-Subtractor shown in the following figure.

Create

1. Generate -6V and +8V output for a given 2V input signal using two different op-amp circuits by selecting suitable resistance values.
2. A 741C op-amp is used as an inverting amplifier with a gain of 50. The voltage gain vs. Frequency Curve of 741C is flat up to 20 KHz. Predict the maximum peak to peak input signal to get undistorted the output?
3. Generate an output of -5V for the given input 1V input op-amp circuit (Assume the input resistance R_1= 10kΩ
4. Combine an inverting and a non inverting amplifier to amplify a 2V signal into 10V
5. Derive a differential amplifier circuit with R_1=10 KΩ and the gain=5.
6. Produce an output of 3V using an op-amp circuit for the given 8V signal.
7. Derive an adder circuit using op-amp to produce the output expression as V 0 =-(0.1V1 +V2 +10V3) where V1, V2 and V3 are the inputs.
8. Produce logic 1(Positive saturation) output using op-amp a circuit, when the input exceeds 2V. The circuit should also provide a logic 0 (Negative saturation) output when the input is less than 2V. Conclude the circuit operation along with input and output waveforms.
9. Derive a circuit to generator waveform with a frequency of 100Hz and duty cycle of 75% using 555 –timer. (Assume capacitance value = 0.1µF) and produce the steps to derive the circuits.
10. Derive an instrumentation amplifier circuit to produce 10V output for the inputs 2V and 4V. (Assume the resistance values R_2=2kΩ and R_3 =10kΩ.)
11. Produce a circuit using various resistances to convert 3 bit digital into analog and explain its operation
12. Produce a table to indicate analog to digital conversion steps, when 2.2V analog input is given to successive approximation type A/D convertor.(Given the reference voltage = 5V)
13. Derive an expression for the frequency of oscillation in the VCO.
14. Derive the expression for lock-in-rang in PLL
15. Derive the expression for capture-rang in PLL
16. Generate a 3 kHz rectangular waveform using a 555-timer based monostable multivibarator (Assume C_T=0.01µF, V_{cc}= 8V) and generalize its operating process.
17. Generate a 5 kHz signal using Voltage controlled Oscillator circuit and generalize its operating process. (Assume C_T=0.01µF, V_{cc}= 8V and V_c=2V)

15EI407 SENSORS AND TRANSDUCERS LABORATORY

0 0 2 1

Course Objectives

- To interpret the introductory concepts of Matrices and Calculus, which will enable them to model and analyze physical phenomena involving continuous changes of variables
- To summarize and apply the methodologies involved in solving problems related to fundamental principles of Matrices and Calculus
- To develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Demonstrate a resistive transducer for the measurement of displacement and force
2. Implement the signal conditioning unit for resistance thermometer and linearization of thermistor
3. Attribute the input and output parameters of inductive and capacitive transducers
4. Design the signal conditioning circuit for RTD and linearization circuit of thermistor
5. Organize various factors involved in the measurement of light intensity and speed using optical transducer

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2		1							1	
2	1	2	3	2		1							1	
3	1	3	2	2		1								
4	1	3	2	2					1					
5	1	3	2	2					1					

1 **6 Hours**

EXPERIMENT 1

Measurement of linear displacement and Pressure using inductive transducer.

2 **6 Hours**

EXPERIMENT 2

Design of signal conditioning circuit for resistance thermometer.

3 **3 Hours**

EXPERIMENT 3

Measurement of magnetic field using Hall Effect transducer.

4 **3 Hours**

EXPERIMENT 4

Liquid level measurement using capacitive transducer.

5 **6 Hours**

EXPERIMENT 5

Measurement of light intensity using optical transducers.

6 **6 Hours**

EXPERIMENT 6

Design of linearization circuit for thermistor.

7 **3 Hours**

EXPERIMENT 7

Vibration measurement using Piezo electric accelerometer.

8 **3 Hours**

EXPERIMENT 8

Measurement of force using strain gauge and load cell

9 **3 Hours**

EXPERIMENT 9

Measurement of linear and angular displacement using resistive transducer.

10 **6 Hours**

EXPERIMENT 10

Measurement of speed using digital shaft angle encoder

Total: 45 Hours

15EI408 LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY

0 0 2 1

Course Objectives

- To design and verify various digital logic circuits
- To understand the characteristics and applications of op-amp
- To design the application oriented experiments based on IC 741 and IC 555

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Design the combinational circuits using logic gates
2. Design and implement the sequential logic circuits flip flops, shift registers and counters
3. Demonstrate the monostable and astable multivibrators using NE/SE 555
4. Construct the differentiator, Integrator ADC, and DAC circuits using Op-Amp
5. Select Timer IC Application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2	2				1		1	1	2	
2	3	1	1	2	1				1		2	1	2	
3	2	3	1	2	1				1		2	2	1	
4	2	2	1	3	2				1		1	2	2	
5	3	2	1	2	3						2	1	2	

1 **3 Hours**

EXPERIMENT 1

Design and Implementation of Full Adder and Full Subtractor Circuits

2 **3 Hours**

EXPERIMENT 2

Realize the Code converters - Gray to Binary, Binary to Gray code, Parity generator and Parity Checker using Logic Gates

3 **3 Hours**

EXPERIMENT 3

Implementation of 4:1 Multiplexer,1:4 De-multiplexer,4:2 Encoder and 2:4 Decoder

4 **6 Hours**

EXPERIMENT 4

Verification of Functional Tables of RS, JK, T and D flip-flops using ICs

5 **6 Hours**

EXPERIMENT 5

Design and implementation of 4-bit Shift Registers in SISO, SIPO, PISO, PIPO modes using suitable ICs

6 **6 Hours**

EXPERIMENT 6

Design and implementation of 4-bit modulo Synchronous and Asynchronous Counters using flips-flops

7 **6 Hours**

EXPERIMENT 7

Design of Astable and Mono-stable Multi-vibrator using NE/SE 555 Timer

8 **6 Hours**

EXPERIMENT 8

Application of Op-Amp (Inverting, Non-Inverting amplifier, Comparator, Integrator and Differentiator)

3 Hours

9

EXPERIMENT 9

Design of 2 bit Analog to Digital Converter

10 **3 Hours**

EXPERIMENT 10

Design of 4 bit Digital to Analog Converter

Total: 45 Hours

0 0 2 1

15EI409 MINI PROJECT II

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	1	2	2	3	3	2	3	3	3	3
2	2	2	3	2	3	1	2	3	3	1	3	3	3	3
3	2	2	3	2	3	1	2	2	3	1	2	3	3	3
4	2	2	3	2	3	3	2	3	3	3	3	3	3	3
5	2	2	3	1	3	1	2	2	3	3	2	3	3	3

Total: 0 Hours

15GE410 LIFE SKILLS: VERBAL ABILITY 0 0 2 0

Course Objectives

- Read and understand business passages
- Employ various types of sentences in Business Correspondence
- Equip students with strategies for vocabulary development

Programme Outcomes (POs)
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. The students will be able to: Read and understand business related articles
2. Identify errors in the given sentences
3. Attempt vocabulary related questions in competitive exams
4. Write coherent business letters, e-mails, reports and proposals
5. Write instructions and descriptions related to business contexts

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										3				
3										3				
4										3				
5										3				

1 **15 Hours**

UNIT 1

Synonyms - Antonyms - Word groups - Verbal analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitutes - Idioms and Phrases - Text and Paragraph Completion

2 **15 Hours**

UNIT 2

Sentence formation - Paragraph formation- Change of voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors - Homophones - Homonyms - Commonly Mispronounced/Misspelt Words

Total: 30 Hours

Reference(s)

1. Raymond Murphy. English Grammar in use - A Self-Study Reference And Practice Book For Intermediate Learners of English.- IV ed. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. Goyal Saab Publisher, 2011.
3. Baron's the Official Guide for New GMAT Review 2015. New Jersey : John Wiley & Sons, Inc.

15EI501 CONTROL ENGINEERING 3 2 0 4

Course Objectives

- To understand the different methods of system representation and obtain the transfer function model for various types of systems
- To impart necessary knowledge in the time domain and frequency domain responses
- To give basic knowledge in stability analysis, state space analysis and to designing compensators for a control system

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Generate the mathematical model for a given system
2. Determine the response of different order systems for various inputs
3. Attribute the factors involved in frequency response by using various methods
4. Check the stability using various methods and Design a compensator for a given system using time domain
5. Produce the system in various state space models

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2		1						2	1	2
2	3	2	2	2		1						2	1	2
3	3	2	3	2		1						2	1	2
4	3	2	3	3		1						3	1	3
5	3	2	3	3		1						3	1	3

UNIT I **9 Hours**

MATHEMATICAL MODEL OF PHYSICAL SYSTEMS

Open loop and closed loop systems with examples - Elements of control system - Mathematical representation of systems - Transfer function of simple mechanical, electrical and thermal systems - Transfer function of overall systems using block diagram reduction technique - Signal flow graph.

UNIT II **7 Hours**

TIME DOMAIN ANALYSIS

Standard test signals - Transient response of first and second order systems - Time domain specifications - Steady state errors and error constants - Generalized error series - Dominant poles of transfer functions - P, I, PD, PI and PID models of feedback control systems.

UNIT III **9 Hours**

FREQUENCY DOMAIN ANALYSIS

Frequency response of systems - Frequency domain specifications - Polar plot - Bode plot - Constant M and N circles - Nichols chart - Nichols plot.

UNIT IV **11 Hours**

STABILITY ANALYSIS AND COMPENSATOR DESIGN USING TIME DOMAIN

Concepts of stability - Characteristic equation - Routh-Hurwitz criterion - Root-Locus technique - Design Specifications - Lag, lead and lag-lead networks - Cascade compensator design using time domain analysis.

UNIT V **9 Hours**

STATE VARIABLE ANALYSIS

Introduction to state space analysis - State model of linear system - State space representation using physical variables, phase variables, canonical variables.

FOR FURTHER READING

Transfer function of Speed Controlled DC motor - Transient response of thermistor - Performance analysis of PI, PD and PID controller for thermal process - Stability analysis of linear system - State space representation using electromechanical system.

Total: 75 Hours

Reference(s)

1. I.J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, 2011
2. K. Ogatta, Modern Control Engineering, Pearson Education, New Delhi, 2011
3. Benjamin C. Kuo, Automatic Control Systems, Prentice-Hall of India Pvt. Ltd. 2012
4. M. Gopal, Control System Principles and Design, Tata McGraw-Hill, 2012
5. M. N. Bandyopadhyay, Control Engineering Theory and Practice, Prentice Hall of India, 2009

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	4	4			4	4																			16
2	4				2	4				6				2				2							20
3	8				2					6				2	3										21
4		4			4					6				2	3				2						21
5		4				6				6				6											22
																								Total	100

Assessment Questions

Remember

1. Define control system.
2. State Masons Gain formula.
3. Label the different types of test signals.
4. List the time domain specifications.
5. List the frequency domain specifications.
6. Define gain margin and phase margin.
7. Recall the Routh stability condition.
8. Label the different types of compensators.
9. List any four advantages of state space analysis.
10. Define phase variables.

Understand

1. Compare between open loop and closed loop system.
2. Infer the block diagram.
3. Classify the system depending on the value of damping ratio.
4. Indicate the relation between static and generalized error coefficients.
5. Illustrate the M and N circles.
6. Summarise the closed loop frequency response is determined from the open loop frequency response using Nichols chart.
7. Indicate the necessary condition for stability.
8. Summarize the factors to be considered for choosing series or shunt/feedback compensation.
9. Compare state and state variables.
10. Illustrate the state diagram.

Apply

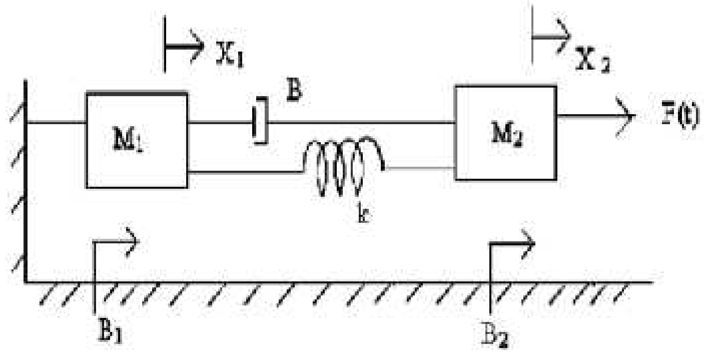
1. A negative feedback closed loop system is supplied to an input of 5V. The system has a forward gain of 1 and feedback gain of 1. Compute its output voltage.
2. Show the rule for moving the summing point ahead of a block.
3. A second order system has a damping radio of 0.6 and natural frequency of oscillation is 10 rad/sec. Find the damped frequency of oscillations.
4. The damping ratio & natural frequency of oscillation of a second order system is 0.6 and 8 rad/sec respectively. Find the rise time.
5. Show the polar plot of G(s) =1 / [s2(1+sT1) (1+sT2) (1+sT3)]
6. Find the magnitude and phase of closed loop transfer function with unity feedback and prove that it is in the form of circles for every value of M and N.
7. Construct Routh array and find the stability of the system whose characteristics equation is s6+2s5+8s4+12s3+20s2+16s+16=0.Also compute the number of roots lying on right half of s-plane, left half of s-plane and imaginary axis.Â
8. Realize the Lag, Lead and Lag-Lead compensator using electrical network and find its transfer function.
9. A system is characterized by the differential equation d2y/dt2+10dy/dt+7y-u=0.Find its transfer function.
10. Show the state model of the system whose transfer function is given asY(s)/U(s)=10/s3+4s2+2s+1

Analyse

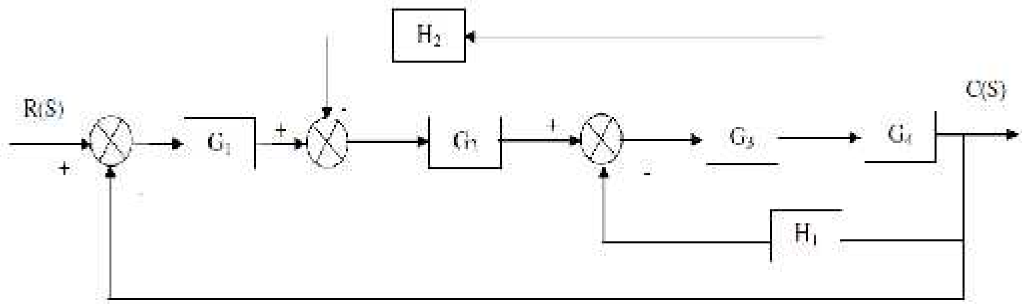
1. Compare the lag, lead and lag-lead compensator.
2. Develop the transfer function of electrical and electromechanical systems.
3. Determine the transfer function of thermal system.
4. Analyze the transfer function of hydraulic and pneumatic systems.
5. For a given system G(s) = 10(s+1) / (s2+13s+10), how to detect steady state error and error constants?
6. Analyze the stability of the system using routh hurwitz criterion, root locus technique or nyquist stability criterion.
7. For a given transfer function G(s) =10/(s+1) (s+2), Design the lag, lead and lag lead networks.

Evaluate

1. Determine the transfer function, $\frac{X_1(s)}{F(s)}$ and $\frac{X_2(s)}{F(s)}$ for the system shown in figure.



Determine the overall transfer function C(S)/R(S) for the system shown in figure.



2. Determine the response of unity feedback system whose open loop transfer function is G(s) = 4/s(s+5) and when the input is unit step.
3. The unity feedback control system has an open loop transfer function *G(s)*= $\frac{10}{s(s+2)}$. Determine the time domain specifications for a unit step input.
4. Sketch the bode plot for the following transfer function and determine phase margin and gain margin. G(s) = $\frac{75(1+0.2s)}{s(s^2+16s+100)}$.
5. The open loop transfer function of a unity feedback system is given by G(s) = $\frac{1}{s^2(1+s)(1+2s)}$.
6. Sketch the polar plot and determine the gain margin and phase margin.
7. Determine the root locus for the unity feedback system whose open loop transfer function is G(s) H(s) = $\frac{K}{s(s+4)(s^2+4s+20)}$ and sketch the plot.
8. Compare the lag, lead and lag-lead compensator.
9. A feedback system has a closed loop transfer function $\frac{Y(s)}{U(s)} = \frac{10(s+4)}{s(s+1)(s+3)}$. Determine the three different state models for this system.
10. Determine the state model of field controlled DC motor.

Create

1. Derive the transfer function of armature controlled DC motor.
2. Derive the expression for under damped second order system when the input is unit step and plot the response of the system.

15EI502 SMART AND WIRELESS INSTRUMENTATION 3 0 0 3

Course Objectives

- To introduce the measurement system and sensors for various applications.
- To understand the manufacturing techniques and different types of Micro sensors and actuators.
- To give a comprehensive knowledge on smart sensor Design, Development and Challenges.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Interpret the static and dynamic characteristics of the measurement system
2. Identify the sensor for measurement of spatial, chemical and optical variables
3. Implement the signal conditioning circuit and communication protocol for smart sensors
4. Design and fabrication of Micro sensors and actuators for industrial applications
5. Analyze the recent trends in the sensor technologies (RF-IDs - Sensor arrays - Sensor networks)

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1									2	
2	2	2	1	1							1	1	2	
3	3	2	3	2	2	1			1		2	1	3	
4	2	1	3	3	3	1			1		2	1	2	
5	3	2	2	2	3						2	2	3	

UNIT I **10 Hours**

INTRODUCTION TO MEASUREMENT SYSTEMS

General concepts and terminology, Measurement systems, Sensor classification, Static characteristics of measurement systems-accuracy, Linearity, Resolution, Precision and sensitivity etc., Estimation of errors, Dynamic characteristics of measurement systems, Zero order first-order and second-order measurement systems and response.

UNIT II **10 Hours**

SENSORS FOR SPATIAL VARIABLES, OPTICAL VARIABLES, CHEMICAL VARIABLES

Spatial variable measurement: Laser Interferometer Displacement sensor-synchro /Resolver displacement transducer. Optical variables measurement - Chemical variables measurement - Thermal composition measurement - Environmental measurement: Meteorological measurement - Air pollution measurement - Water quality measurement - Satellite imaging and sensing.

UNIT III **9 Hours**

SMART SENSORS

Primary and Secondary sensors - Amplification - Filters - Converters - Compensation - Information coding / processing - Data communication, standards for smart sensor interface - Smart transmitter with HART communicator - Smart sensor for flow and temperature measurement.

UNIT IV **8 Hours**

MICRO SENSORS AND ACTUATORS

Micro system design and fabrication - Micro pressure sensors (piezo resistive and capacitive) Resonant sensors - Acoustic wave sensors - Bio micro sensors - Micro actuators - Micro mechanical motors and pumps.

UNIT V **8 Hours**

RECENT TRENDS IN SENSOR TECHNOLOGIES

Film sensors : Thick film and thin film - Integrated image sensors - Bio sensors - Integrated micro arrays - RF - IDs - Sensor arrays - Sensor network - Multisensor data fusion - Soft sensor.

FOR FURTHER READING

Integration of Wireless Sensor Network with Virtual Instrumentation in a Hazardous Environment - Wireless Data Acquisition in LabVIEW - ZIGBEE based wireless data acquisition using LabVIEW for implementing smart driving skill evaluation system.

Total: 45 Hours

Reference(s)

1. Ernest O Doebelin and Dhanesh N Manik, Measurement Systems Application and Design, 5thEdition, Tata Mc-Graw Hill, 2012.
2. John G Webster, Measurement, Instrumentation and Sensors Handbook, CRC press IEEE press, 2010.
3. Ifan G. Hughes and Thomas P.A. Hase, Measurements and their Uncertainties: A Practical Guide to Modern Error Analysis, Oxford University Press, 2010.
4. Gerord C.M. Meijer, Smart Sensor Systems, John Wiley and Sons, 2013.
5. Tai-Ran Hsu, MEMS and Micro Systems: Design and Manufacture, Tata McGraw Hill, 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	6					6				4				4											20
2	4					6				4				4				2							20
3	2					6					4				4				4						20
4	2					6					4				4			4							20
5	2					4				4					6				4						20
																								Total	100

Assessment Questions

Remember

1. List two functional elements of the measurement systems.
2. What are the main static characteristics?
3. Define static error.
4. List the types of errors in measurements.
5. Mention the various temperature scales and relation between them.
6. What are the major sources of error?
7. Recognize the concept of smart sensor.
8. Define Wireless Sensor Network.
9. State the deployment options for WSNs.
10. Define mobility.

Understand

1. Draw the block diagram showing the basic functional elements of instrument and explain the functions of each.
2. Explain the static and dynamic characteristics of a measurement system.
3. Explain in detail the different types of errors in measuring instruments.
4. Explain the various challenges of wireless sensor networks.
5. Illustrate the innovative mechanisms to realize the characteristic requirements of WSN
6. Compare centric paradigm and data centric paradigm.
7. Classify the various approaches of error control.
8. Summarize the features of link management.
9. Illustrate the bio micro sensor with its neat diagram.
10. Exemplify the operation of acoustic wave sensor.
11. Infer the recend trends in RF ID sensor.

Apply

1. Implement five static characteristics of an instrument in a measurement system.
2. Select a suitable measurement system to estimate the errors.
3. Implement the sensor in chemical field to identify the variable measurement.
4. Execute the operation of sensor in air pollution measurement.
5. Use the smart sensor to measure the parameters like flow and temperature.
6. Show the smart sensor working in data communication.
7. Implement the design of micro sensor and its fabrication.
8. Select a suitable sensor for pressure measurement.
9. Show the sensor technologies trends in integrated image sensor.

Analyse

1. Compare static and dynamic characteristics of measurement system.
2. Analyze the operation of smart transmitter with HART communicator.
3. Differentiate primary and secondary sensors.
4. Compare the features of thick and thin film sensors.

Evaluate

1. Determine the response of zero order, first order and second order measurement system.
2. Determine the operations of acoustic wave sensor.
3. Determine the functions of soft sensor.

Create

1. Create a ZIGBEE based wireless data acquisition system for implementing smart driving.
2. Generalize the latest sensor technology in smart home security system.

15EI503 MICROPROCESSORS AND MICROCONTROLLERS

3 2 0 4

Course Objectives

- Interpret the architecture and fuctions of 8085 microprocessor
- Explain the architecture and functions of 8086 microprocessor
- Analyze the concept of peripheral interfaces used in microprocessor
- Interpret the architecture and functions of 8051 microcontroller
- Develop program to interface the peripheral devices with 8051 microcontroller

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Interpret the architecture and functions of 8085 microprocessor
2. Explain the architecture and functions of 8086 microprocessor
3. Analyze the concept of peripheral interfaces used in microprocessor
4. Interpret the architecture and functions of 8051 microcontroller
5. Develop program to interface the peripheral devices with 8051 microcontroller

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	2	2	2					2		-
2	3	2	3	2	2	2	3					2		-
3	2	3	3	2	3	2	3					2		-
4	2	3	3	2	3	2	3					2		-
5	2	3	3	2	2	2	3					2		-

UNIT I **9 Hours**

INTEL 8085 MICROPROCESSOR

Functional block diagram - Registers, ALU, Bus systems, Addressing modes. Basic interfacing concepts - Memory Interfacing, I/O Interfacing - Timing constraints - Memory control signals - Read and write cycles - Interrupt - Types of Interrupts, Methods of servicing Interrupts - Need for direct memory access - DMA transfer types.

UNIT II **9 Hours**

INTEL 8086 MICROPROCESSOR

Register organization of 8086 - Architecture, Modes of operation - Physical memory organization - I/O addressing capability - Special Processor activities- assembler directives: Addressing modes of 8086 - Instruction set of 8086 - Assembler directives and operators.

9 Hours

UNIT III

PERIPHERALS INTERFACING WITH 8085

Study of Architecture and Programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter - A/D and D/A converter interfacing.

UNIT IV **11 Hours**

MICROCONTROLLER

Introduction to 8051 microcontroller, 8051 Architecture, Microcontroller hardware, Input /Output ports and circuits, External memory, counters and Timers, Serial Communication Interface (SCI), Serial Peripheral Interface (SPI), Analog-to- Digital Converter, Hardware and Software Development Tools, C Programming Language.

UNIT V **7 Hours**

PROGRAMMING AND APPLICATIONS WITH 8051

Data Transfer, Manipulation, Control & I/O instructions, Temperature Sensor (LM35) Interfacing, Stepper motor control and UART interfacing.

FOR FURTHER READING

Introduction to PIC micro controllers -Advantage of PIC micro controllers, Microcontroller Architecture LCD, LED and 7 Segment Interfacing, Analog to digital conversion, UART Implementation

Total: 75 Hours

Reference(s)

1. Ramesh Goankar, Microprocessor Architecture, Programming and Applications with 8085, PenramInternational, six edition, 2013
2. Kenneth J Ayala, 8051 Microcontroller: Architecture, Programming and Applications, Delmar Learning, 2007
3. John B Peatman, Design with PIC Microcontrollers, Pearson Education Asia, Low price edition, 2012
4. V.Douglas Hall, Microprocessors and Interfacing Programming and Hardware, Tata McGraw Hill, 2010
5. Muhammad Ali Mazidi& Janice GilliMazidi, The 8051 Micro Controller and Embedded Systems, Pearson Education, 5th Indian Reprint, 2012

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2			2	14																			20
2	2	2			2	14																			20
3		2			2	2				12				2											20
4	2	2			2	14																			20
5		2				4				12				2											20
																								Total	100

Assessment Questions

Remember

1. Define processor.
2. List out the general purpose registers in 8085

3. State the timing diagram of 8085.
4. List out the addressing modes used in 8086
5. Recall the use of ALE signal?
6. Recall the use of SFRs in 8051 microcontroller?
7. List out the interrupts of 8051 microcontroller.
8. List the hardware requirement to interface an LCD using 8255.
9. List out the functions performed by 8279.
10. What are the alternate functions of port 3 in 8051 microcontroller?
11. What is servo motor?

Understand

1. Explain the internal hardware architecture of 8085 microprocessor with neat diagram.
2. Explain the data transfer operation of DMA with neat diagram.
3. Explain the internal hardware architecture of 8086 microprocessor with neat diagram.
4. Explain the addressing modes and assembler directives of 8086 microprocessor.
5. Explain the block diagram of 8254 programmable timer with neat diagram.
6. Explain the concept of ADC with 8051 microcontroller
7. Explain the concept of UART with 8051 microcontroller
8. Design an interfacing circuit using a 3-to-8 decoder

Apply

1. To compute the 16-bit sum of N elements of a table. The starting address of table is 4150 whose first entry is the number of elements N. The result is stored at memory location 4140 and 4141.
2. To convert two BCD numbers in memory to the equivalent hex number. The BCD digits are at locations 4150 and 4151 and the result will be stored at 4152.
3. To find the smallest of N numbers using 8086.
4. Demonstrate the analog to digital conversion using 8051 microcontroller
5. Implement the serial communication with PC using 8051 microcontroller
6. Demonstrate the flow diagram, how an instruction is fetched and executed in an 8085 microprocessor?
7. Demonstrate the I/O read and write operation of 8085 processor with timing diagram.
8. Design an 8-key input port with device address FF H using a 3 to 8 decoder to interface with 8085.
9. Write an ALP in 8085 to find the maximum number from the given n numbers.

Analyse

1. Compare the operations like arithmetic, logical, rotate and stack using 8085 ?
2. Compare the operations like arithmetic, logical, rotate and stack using 8051?
3. Draw a block diagram of 8279 and explain the functions of each component
4. Draw a block diagram of 8259 and explain the functions of each component.
5. Compare the features of 8086 over 8085
6. Compare the I/O read and write operation of 8085 processor with timing diagram
7. Compare the LDA and LDAX with an example
8. Compare the memory mapped IO and IO mapped IO

Evaluate

1. Draw a block diagram of 8255 and explain the functions of each component

Create

1. Generalize the concept of real time clock using 8253.
2. Generalize the concept of hardware and software for pre-settable alarm system
3. Generalize the concept of microcontroller system to control traffic signals.
4. Generalize the concept of temperature monitoring system using microcontroller.

15EI504 INDUSTRIAL INSTRUMENTATION I 3 0 0 3

Course Objectives

- To Understand about the construction, characteristics and application of different types of load cells and torque transducers
- To provide exposure on various measuring techniques for acceleration, vibration and density
- To learn the working of different types of pressure transducers
- To analyze the various types of temperature transducers
- To understand, analyze and design various measurement schemes that meet the desired specifications and requirements of real time processes

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Examine the design, construction and features of velocity, torque and force measuring devices.
2. Analyze the characteristics of displacement, acceleration, vibration and density
3. Analyze the characteristics of pressure measurement and select suitable method for a specified application.
4. Select the suitable temperature measuring Instruments for a given applications.
5. Examine various methods of temperature measurement using thermocouples.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1	1									
2	3	1	2	3	3									
3	1	2	3	2	1									
4	2	1	3	2	1									
5	2	1	3	1	3									

UNIT I **9 Hours**

MEASUREMENT OF VELOCITY, TORQUE AND FORCE

Measurement of linear velocity : moving magnet, moving coil and seismic velocity transducer - Measurement of angular velocity - electromagnetic tachogenerators, photo electric and variable reluctance tachometers - torque measurements using resistive, inductive, magnetostrictive and digital transducers - measurement of force - load cell - strain gauge and LVDT load cells, pneumatic and hydraulic load cells.

UNIT II **9 Hours**

MEASUREMENT OF DISPLACEMENT, ACCELERATION, VIBRATION AND DENSITY

Measurement of linear and angular displacement - potentiometer, LVDT, piezo-electric, strain gauge accelerometers - measurement of vibration - seismic instrument as an accelerometer and vibrometer - density and specific gravity - Baume and API(American Petroleum Institute) scales - pressure head type densitometer - float type densitometer - ultrasonic densitometer - bridge type gas densitometer.

UNIT III **9 Hours**

PRESSURE MEASUREMEN

Units and definitions - standards of pressure - manometers, elastic type - bourdon tubes, diaphragm gauges, bellow gauges - bell gauges - electrical types - vacuum gauges: McLeod gauge, pirani gauge, thermocouple gauge, ionization gauge -electrical type differential pressure transmitters - calibration of pressure gauges using dead weight tester

UNIT IV **9 Hours**

TEMPERATURE MEASUREMENT I

Definitions and standards : techniques and classifications - bimetallic thermometers, different types of filled in system thermometer - sources of errors in filled in systems and their compensation - electrical methods of temperature measurement -signal conditioning of industrial RTDs and their characteristics - 3 lead and 4 lead RTDs - 2 wire and 4 wire transmitters -IC temperature sensor - thermistor, linearization, thermowell -head mounted temperature transducer.

UNIT V **9 Hours**

TEMPERATURE MEASUREMENT II

Thermocouples -laws of thermocouple -types of thermocouple -fabrication of industrial thermocouples - signal conditioning of thermocouple output -thermal block Reference(s)junctions - cold junction compensation - response of thermocouple - special techniques for measuring high temperature using thermocouple - radiation methods of temperature measurement - radiation fundamentals - total radiation and selective radiation pyrometers - optical pyrometer -two colour radiation pyrometer

FOR FURTHER READING

Ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats.

Total: 45 Hours

Reference(s)

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011
2. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 2011

3. Ernest O. Doebelin, Measurement systems Application and Design, McGraw Hill Book Company, NewYork, 2007
4. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 2006
5. B. C. Nakra and K. K. Chaudary, Instrumentation Measurement and Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2006
6. K.Krishnaswamy and S.Vijayachitra, Industrial Instrumentation, New age International Private limited, 2005

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2					6					6			6											20
2	2					2				4					4				6						18
3		2			2						6			6					6						22
4		2					6				8				6										22
5	2						4			6									6						18
																								Total	100

Assessment Questions

Remember

1. State the features of seismic velocity transducer.
2. List the different types of load cells
3. List the different units for pressure measurement.
4. Differentiate between gauge pressure and vacuum pressure.
5. State the principle involved in thermistor.
6. List any two factors, which decide the response of thermocouple to process temperature.
7. Define linearization.
8. List out the five properties of a material which should be an element of a bimetallic strip.
9. Mention any two limitations of a total radiation pyrometer.

Understand

1. Illustrate the construction and working of variable reluctance accelerometer.
2. Indicate the different methods used for pressure measurement and explain with example.
3. Explain the McLeod gauges used for vacuum pressure measurement and its limitations.
4. Compare API (American Petroleum Institute) and Baume scale.
5. Classify the pyrometers and explain the operation of optical pyrometer.
6. Illustrate the operation of signal conditioning circuit used for an industrial RTD.
7. Classify the pyrometers and explain the operation of optical pyrometer.
8. Exemplify the atmospheric pressure in terms of bar and kg/cm2 scales.
9. explain about the laws of thermocouple and infer some special techniques used for high-temperature measurement using thermocouple.
10. Â Elucidate ultrasonic densitometer and its limitations
11. Apply the magnetostrictive effect to torque measurement and explain its operation.

Apply

1. Apply the magnetostrictive effect to torque measurement and explain its operation.

2. Calculate the torque developed by a motor shaft when it is running at 1500 rpm and delivering shaft power of 5 Horse power.
3. Construct the functional block diagram of AD595 thermocouple signal conditioning circuit
4. Select a piezoelectric material and produce various measuring application based on the material.
5. Generalize the procedure to measure pressure using elastic diaphragm.
6. Prepare a conversion chart for various types of temperature scales.
7. The mass and spring constant of seismic instrument (Mechanical type) is given below. Calculate the natural frequency and critical damping ratio. m = 0.005 kg, k = 500 N/m.
8. Change the specific gravity at 60o C into Degree API and Degree Baume scales
9. Prepare conversion charts for various types of pressure scales
10. Classify the mechanical instruments for measurement of pressure and explain the process to judge the pressure by comparing known and unknown pressures.

Analyse

1. Compare 3-types of load cell spring elements.
2. Identify the role of protection tubes and thermowells in temperature measurement.
3. Compare various types of thermocouples in terms of their material combinations in positive and negative terminals, accuracy, measurement range and applications
4. Determine which type of transducer is used for contaminated fluid density measurement.

Evaluate

1. Create a thermocouple to measure 0 to 900oC temperature by selecting suitable metal combinations for positive and negative legs and design a signal conditioning circuit to get 1V for maximum change in temperature. Assume the sensitivity of thermocouple =51.7µV/oC.
2. Are bourdon tubes also used as differential pressure gauges? Justify.
3. Determine the specific gravity of a float if it just submerges in a liquid of density 1200 kg/m3.
4. Can seismic instrument act as an accelerometer and vibrometer? Justify.
5. Design a signal conditioning circuit for electrical method of pressure measurement.

Create

1. Design a pressure transmitter to provide 0-5V for 0 -50 psi pressure variations using LVDT and elastic type conversion elements. Sensitivity of the elastic material is 0.1mm/psi and sensitivity of LVDT is 1mV/mm
2. Create a thermocouple to measure 0 to 900oC temperature by selecting suitable metal combinations for positive and negative legs and design a signal conditioning circuit to get 1V for maximum change in temperature. Assume the sensitivity of thermocouple =51.7µV/oC.

15EI507 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

0 0 2 1

Course Objectives

- To study the Architecture, addressing modes & instruction set of 8085, 8051 and PIC Microcontroller
- To develop skill in simple program writing
- To introduce commonly used peripheral / interfacing ICs

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Develop an assembly language program for performing arithmetic operations using 8085
2. Implement sorting and code conversion algorithm using assembly language in 8085
3. Execute an assembly language program for performing arithmetic operations using 8051
4. Interface the stepper motor, ADC, DAC and traffic light with 8051 microcontroller
5. Execute an embedded program to interface LCD and ADC with PIC microcontroller

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		3	2									
2	2	2		2	2									
3	2	3		2	2									
4	2	3		2	2									
5	2	3	3	2	2									

1 **6 Hours**

EXPERIMENT 1

16 bit arithmetic operation

2 **6 Hours**

EXPERIMENT 2

Code conversion.(Binary to Grey and vice versa)

3 **6 Hours**

EXPERIMENT 3

Arithmetic program to find square, LCM, and GCD

4 **3 Hours**

EXPERIMENT 4

Sorting.(Ascending and Descending order)

5 **6 Hours**

EXPERIMENT 5

BCD addition and Subtraction

6 **6 Hours**

EXPERIMENT 6

Implement Traffic Light controller using 8051 Microcontroller

7 **3 Hours**

EXPERIMENT 7

Interface ADC/DAC with 8051 Microcontroller

8 **3 Hours**

EXPERIMENT 8

Interface stepper motor with 8051 Microcontroller

9 **3 Hours**

EXPERIMENT 9

Interfacing LCD with PIC Microcontroller

10 **3 Hours**

EXPERIMENT 10

Interfacing ADC with PIC Microcontroller

Total: 45 Hours

15EI508 CONTROL ENGINEERING LABORATORY 0 0 2 1

Course Objectives

- To strengthen the concept of mathematical modeling and feedback control
- To impart necessary knowledge in time response and frequency response analysis
- To understand controller or compensator design concepts for a given system.
- To understand the concept of stability analysis

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Develop the mathematical model of the given system
2. Analyze the time response for the given system.
3. Analyze the frequency response for the given system.
4. Design a controller or compensator for the given system to meet the desired specifications.
5. Investigate the stability of the given system using time domain and frequency domain methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	3							2		
2	3	3	3	2	3							2		
3	3	3	3	3	2							2		
4	3	3	3	3	2							2		
5	3	3	3	2	2							2		

1 **6 Hours**

EXPERIMENT 1
Estimation of transfer function of DC servo motor.

2 **3 Hours**

EXPERIMENT 2
Determine the transfer function of AC servo motor.

3 **3 Hours**

EXPERIMENT 3
Design and simulation of linear and nonlinear systems.

4 **6 Hours**

EXPERIMENT 4
Digital simulation of Type-0 and Type-1 system.

5 **3 Hours**

EXPERIMENT 5
Time response analysis using simulation software

6 **6 Hours**

EXPERIMENT 6
Frequency response analysis using simulation software

7 **3 Hours**

EXPERIMENT 7

Performance analysis of P, PI and PID controllers.

8 **6 Hours**

EXPERIMENT 8

Stability analysis of linear systems.

9 **9 Hours**

EXPERIMENT 9

Compensator design using simulation software

Total: 45 Hours

15EI509 TECHNICAL SEMINAR I 0 0 2 1

Course Objectives

- To develop self-learning skills of utilizing various technical resources to make a technical presentation
- To promote the technical presentation and communication skills
- To impart the knowledge on intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds
- To promote the ablility for Interacting and sharing attitude
- To encourage the commitment-attitude to complete tasks

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple fields
2. Improve the technical presentation and communication skills
3. Analyze the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.
4. Interact and share their technical knowledge to enhance the leadership skills
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2			1	1		1	2	2		2		
2		1			1	1		1	2	2		2		
3		2			2	1		1	2	2		2		
4		3			2	1		2	3	2		2		
5		3			2	1		2	3	2		2		

Total: 0 Hours

15EI510 MINI PROJECT III **0 0 2 1**

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies, and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)
1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	1	2	2	3	3	2	3	3	3	3
2	2	2	3	2	3	1	2	3	3	1	3	3	3	3
3	2	2	3	2	3	3	2	3	1	2	2	3	3	3
4	2	2	3	2	3	3	2	3	3	3	3	3	3	3
5	2	2	3	1	3	3	2	2	3	3	2	3	3	3

Total: 0 Hours

15GE511 LIFE SKILLS: APTITUDE I 0 0 2 0

Course Objectives

- To expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.

Programme Outcomes (POs)
a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Distinguish the pattern of coding and decoding.
2. Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions
3. Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors
4. Calculate the percentages and averages

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				3	1							
2	3	2				2	1							
3	3	2				3	1							
4	3	2				2	1							

1 **3 Hours**

CODING AND DECODING

Introduction - Description of Coding method - Coding patterns - Concepts of Coding and Decoding - Problems involving Coding and Decoding methods

2 **3 Hours**

SEQUENCE AND SERIES

Introduction - Sequences of real numbers - Number and Alphabet series - Description of Number and Alphabet series - Analogy - Odd man out- Power series

3 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid

4 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems -Direction - Plotting diagrams

5 **3 Hours**

PROBLEM ON AGES

Introduction- basic concept - usage of percentage and averages- applications

6 **3 Hours**

ANALYTICAL REASONING

Introduction - basic concept - non verbal analytical reasoning - arrangements

7 **3 Hours**

BLOOD RELATION

Introduction - Basic concept - Kinds of relation - Tree diagram - Relations

8 **3 Hours**

BLOOD RELATION

Introduction -Basic concept - Kinds of relation - Tree diagram - Relations

9 **3 Hours**

VISUAL REASONING

Introduction - Basic concepts - Odd man out - Next series - Mirror image and water image

10 **3 Hours**

SIMPLIFICATIONS

Introduction - Basic concepts - Arithmetic operations -Equation solving methods - Puzzles

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
4. Edgar Thorpe , Course In Mental Ability And Quantitative Aptitude For Competitive Examinations, Third Edition, Tata McGraw-Hill Publishing Company Ltd, 2013.
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

15GE701 ENGINEERING ECONOMICS 3 0 0 3

Course Objectives

- To introduce the concepts of micro, macro economic systems and business decisions in organizations.
- To acquire knowledge on laws of demand & supply and methods of forecasting the demand
- To emphasis the systematic evaluation of the costs, breakeven point for return on economics and diseconomies
- To acquaint in pricing methods, payback and competition in modern market structure
- To obtain knowledge on macro economics, various taxes and financial accounting procedures

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Explain the micro economic environment for creating a favourable business environment.
2. Make use of the major concepts and techniques of engineering economic analysis in real time applications.
3. Compare the cost of multiple projects by using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
4. Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
5. Examine and evaluate the issues in macro-economic analysis.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2							
2											3	2		
3						2	2				2	2		
4						2	2			3	2	-		
5						2	2			2	2	-		

UNIT I **9 Hours**

INTRODUCTION

Introduction to Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier - Opportunity Cost - Objective of Organizations - Kinds of Organization.

UNIT II **9 Hours**

DEMAND AND SUPPLY

Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply - Elasticity of Demand - Demand Forecasting Methods - Indifference curve.

UNIT III **9 Hours**

PRODUCTION AND COST

Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-economies of scale - Break Even point.

UNIT IV **9 Hours**

MARKET STRUCTURE

Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methods of Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment - Payback Period.

UNIT V **9 Hours**

INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING

National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct and Indirect Taxes - Fiscal and monetary policies.

FOR FURTHER READING

Nature and characteristics of Indian Economy - Role and functions of Central bank - LPG - GATT - WTO.

Total: 45 Hours

Reference(s)

1. A Ramachandra Aryasri and V V Ramana Murthy, Engineering Economics and Financial Accounting, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. V L Samuel Paul and G S Gupta,Managerial Economics Concepts and Cases, Tata McGraw Hill Publishing Company Limited, New Delhi, 1981.
3. R Kesavan, C Elanchezhian and T Sunder Selwyn, Engineering Economics and Financial Accounting, Laxmi Publication (P) Ltd, New Delhi, 2005.
4. S N Maheswari, Financial and Management Accounting, Sultan Chand
5. V L Samuel Paul and G S Gupta, Managerial Economics-Concepts and Cases

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					8			6											18
2		2					2			8					6				4						22
3			2			2				8								4							16
4	2						2		8						6				4						22
5		2				2				8				6				4							22
																								Total	100

Assessment Questions

Remember

1. Define Economics
2. What is opportunity cost?
3. List the types of Demand.
4. State the law of Demand.

5. Define Elasticity of Demand.
6. State the different degrees of elasticity of Demand?
7. List the factors determining Elasticity of Demand?
8. State the Law Of Diminishing Marginal Utility.
9. Define Replacement Cost and Historic Cost
10. Define Monopoly.
11. Define Oligopoly
12. Name the two types of Oligopoly.
13. List the objectives of Pricing?
14. Define Accounting
15. Define inflation

Understand

1. Explain the nature and scope of Economics.
2. List and explain the focus areas of Managerial economics.
3. Give reasons why mangers aim to maximize sales even at the cost of a lower profit.
4. Explain the nature of Demand.
5. What are the assumptions made when talking about the Law of Diminishing Marginal Utility?
6. Explain the characteristics of the Indifference Curve with examples
7. Can Demand Forecasting principles be applied to Services? Substantiate your answer with an example
8. What are the characteristic features of an oligopoly industry?
9. What causes Oligopoly?
10. Explain the types and features of Cost Based Pricing.
11. Explain the types and features of Demand Based Pricing.
12. Under what conditions does a company go in for Cross Subsidization pricing?
13. What is the role of the Central bank in controlling inflation?

Apply

1. Explain decisions based on the degree of certainty of the outcome with examples.
2. Give examples of products falling under the various kinds of competition, and the reasons they are able to survive in the market.
3. Give six examples of products that fall under Monopolistic Competitive pricing.
4. Give six examples of products that fall under Oligopolistic pricing
5. Pick any six Consumer Items and based on your knowledge of the markets, explain the pricing method that you think is most likely to have been followed for each of these items.

Analyse

1. Differentiate between Macro and Micro economics
2. Differentiate between Extension and Increase in Demand.
3. Distinguish between Cost and Price
4. Compare the merits and demerits of the Deductive Method and the Inductive Method of Investigation
5. The per-capita income of farmers in the country has to be raised by 20% this year to prevent their migration to cities. Discuss this statement from the point of view of Positive and Normative Economics.
6. Decision making improves with age and experience- Discuss.
7. Do a survey of the automotive (only cars) industry and analyze the reasons and timing for discounts offered from the point of view of elasticity of demand

8. How would you modify a sealed bid pricing system to take care of different technical approaches by different bidders for a project for which bids are called for, given that the cost varies depending on the technical approach?

Create

1. Create a matrix consolidating the definitions of the word Economics as defined by the leading Economists in the prescribed textbook. Using this define economics the way you understand it, in less than 50 words.
2. Study the price of a commodity over a period of one year and explain the possible reasons for the fluctuations from an economist‘s point of view
3. You are in a job which is paying you adequately. You are called for an interview for a job that double your salary. Unfortunately you miss the only train that will take you in time for the interview. How will you justify the cost of taking a flight considering the cost concepts you have learnt.?
4. Due to cancellation of an export order, you are stuck with a huge stock of jeans of international quality. Device a pricing strategy for disposing this stock without incurring a loss, considering that it is a very competitive market.

15EI602 PROCESS CONTROL 3 2 0 4

Course Objectives

- To obtain the mathematical models for first order and higher order real-time systems and also understand the characteristics of various controller modes
- To get adequate knowledge about the various controller tuning and multi loop control
- To understand the construction, characteristics and application of different types of actuators for real time applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Compute the mathematical model for a physical process by using mass and energy balance equations
2. Apply suitable control mode for different applications
3. Analyze the various control schemes and obtain optimum controller settings using tuning methods
4. Identify the suitable final control elements for a closed loop systems
5. Apply complex control schemes for various applications and develop the P&ID structure for level and flow control loops

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1										2
2	3	2												2
3	3	2	3	2										3
4	2		2											3
5														

UNIT I **9 Hours**

INTRODUCTION

Need for process control-continuous and batch process - mathematical model of first order process using mass and energy balance equations -two tank interacting and non-interacting process - servo and regulator operation - self-regulation.

UNIT II **11 Hours**

CONTROLLER CHARACTERISTICS

Basic control actions - characteristics and step responses of ON-OFF, floating-control mode, proportional, integral and derivative control modes - composite control modes: P+I, P+D and P+I+D control modes - step response of composite control modes - bumpless transfer - Proportional and derivative kick, reset windup - Electronic controllers to realize various control actions -Guidelines for selection of controller mode.

UNIT III **10 Hours**

TUNING OF CONTROLLERS AND MULTI-LOOP CONTROL

Optimum controller settings- Evaluation criteria -IAE, ISE and ITAE - quarter decay ratio - Tuning of controllers by process reaction curve method - damped oscillation method - Ziegler-Nichols tuning - Feed forward control - ratio control - cascade control - averaging control - inferential and split range control.

UNIT IV **7 Hours**

FINAL CONTROL ELEMENT

I/P and P/I converters - pneumatic and electric actuators - valve positioner - control valve - characteristics of control valves - type of valves: globe, butterfly, diaphragm, ball valves - control valve sizing - cavitation and flashing in control valves - Selection of control valves.

UNIT V **8 Hours**

SELECTED UNIT OPERATIONS

Binary distillation column - reflux control - Case study: control of heat exchange, evaporator control, reactor control, drum level control and combustion control. Piping and Instrumentation Diagram (P&ID) symbols -P&ID for level and flow control loops.

FOR FURTHER READING

Internet based ON/OFF controller - Simulation using virtual instrumentation: Temperature control - Level Control - Flow control.

Total: 75 Hours

Reference(s)

1. Curtis D. Johnson, Process Control Instrumentation technology, Pearson new international edition 2013.
2. George Stephanopoulos, Chemical Process Control, PHI learning Pvt. Ltd., New Delhi, 2012
3. B. Wayne Bequette, Process Control: modelling, Design, and simulation, PHI learning Pvt. Ltd., New Delhi, 2010.
4. Jonathan Love Process Automation Handbook: A Guide to Theory and Practice, Springer, 2010.
5. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 30th reprint 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					6				4				6						20
2	4					4				2				6					4						20
3	2				4					4					4				6						20
4	4					6				4					6										20
5	4					4				12															20
																								Total	100

Assessment Questions

Remember

1. Define process.
2. Recall interacting system and give an example.
3. List the characteristics of ON-OFF controller.
4. Name the different types of control modes.
5. Recall degree of freedom in process.
6. List the merits and demerits of P, I and D controllers.
7. Name some tuning methods for getting optimum controller settings.
8. Define averaging control.
9. Define the flow capacity of a control valve.
10. List the various types of valves used in flow control applications.
11. Label the different types of plugs used in pneumatic valves.
12. Name the various control schemes involved in the heat exchanger process.
13. Recall the various control schemes used in boiler drum level control.

Understand

1. Infer the difference between manipulated variable and controlled variable.
2. Indicate, why is it necessary to choose controller settings that satisfy both gain margin and phase margin?
3. Represent, how the feed forward controller improves the performance of a process.
4. Explain the operation of I/P converter in a control system.
5. Explain the auctioneering control.
6. Explain in detail about the characteristics of continues and discontinues modes of controller.
7. Exemplify the controller settings using Ziegler-Nichols continuous cycling method and write its limitations.
8. Explain the Cascade control with suitable example.

9. Explain about cavitations and flashing in control valves.
10. Illustrate any two control scheme involved in heat exchanging process with neat diagram.

Apply

1. Compute the transfer function H 2 /Q for the two tank system (Assume: Tank 1 and Tank 2 are interacting)
2. Select a suitable control schemes for temperature process and flow process.
3. Compute the advantage of an electronic controller when compared with pneumatic controller.
4. Show how the process reaction curve can be obtained?
5. A tank operating at 50 feet head 51 lpm out flow through a valve and has a cross section area of 10 square feet calculate the time constant.
6. Select the optimum controller settings for the model G(s)=e -0.5s /(4s +1) using process reaction Curve Method.
7. Use the split-range controller to a pressure control process and explain its operation.
8. Select the gain of proportional controller using Ziegler-Nichols method. Consider a unit step change in the set point. The process is second order with kp =5, time constant =2, and damping ratio=3. Assume that Gm (s)=Gf (s) =1 and apply it for interacting system.
9. Predict the importance of air-fuel ratio in combustion chamber.
10. Select the most appropriate types of feedback controller and controller settings for any process.

Analyse

1. Analyze why two interacting capacities have more sluggish response than non-interacting capacities.
2. Distinguish between continuous process and batch process.
3. Judge when a PID controller is preferred rather than PI controller.
4. Distinguish between offset and error.
5. Judge what type of controller is preferred in the inner loop of cascade control?

Create

1. Create the mathematical model and implement a suitable feedback controller with proper controller setting for a two tank interacting system.
2. Design a simple PID controller to maintain the position of an inverted pendulum vertically
3. Derive mathematical model for coupled three tank cylindrical system
4. Generalize the purpose of final control element in a process.
5. Develop the P&I diagram for liquid level control for three tanks. Assume suitable inputs and outputs.

15EI603 INDUSTRIAL INSTRUMENTATION II 3 0 0 3

Course Objectives

- To understand and design the various types of flow meters
- To understand the different types of level measurements adopted in industrial environment
- To acquire knowledge about the principles of humidity, moisture and viscosity measurements

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Examine the design, construction and features of fixed and variable head type flowmeters
2. Analyze the characteristics of mechanical flow meters
3. Analyze the characteristics of electrical type flow meters and select suitable flow meter for a specified flow application
4. Select the suitable level measuring instruments for a given applications
5. Examine various methods of Humidity, Moisture and Viscosity measurement

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1			1	2						3	1
2	2	2				1	2						3	1
3	3	2	2			1	2	3				2	3	1
4	3	2				1	2					1	3	1
5	3	2				1	2					2	3	1

UNIT I **8 Hours**

FLOW METERS I

Theory of fixed and variable head type flow meters - orifice plate - types of orifice plates, pressure tapping and CD variations - venturi tube - flow nozzle - dall tube - pitot tube - installation of head flow meters.

UNIT II **9 Hours**

FLOW METERS II

Positive displacement flow meters : constructional details and theory of reciprocating piston, oval gear and helix type flow meters - inferential meter - turbine flow meter - nutating disc - rotameter - theory and installation - angular momentum mass flow meter - coriolis mass flow meters - thermal mass flow meters.

UNIT III **8 Hours**

FLOW METERS III

Principle and constructional details of electromagnetic flow meter - different types of excitation schemes used - different types of ultrasonic flow meters - laser doppler anemometer - vortex shedding flow meter - target flow meter - solid flow rate measurement - guidelines for selection of flow meter.

UNIT IV **10 Hours**

LEVEL MEASUREMENT

Definition of level - visual indicators - float gauges: different types - level switches - level measurement using displacer and torque tube - bubbler tube - boiler drum level measurement - hydra step systems - electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors - measurement of level of solids - paddle wheel type - differential pressure method.

UNIT V **10 Hours**

MEASUREMENT OF HUMIDITY, MOISTURE AND VISCOSITY

Units and definitions - dry and wet bulb psychrometers - hot wire electrode and hair type hygrometers - dew cell - electrolysis type hygrometer - commercial type dew point meter - moisture terms - different methods of moisture measurement - moisture measurement in granular materials, solid penetrable materials like wood, web type material - capacitance type - NMR probe for moisture detection - viscosity measurement - different methods of measuring viscosity - Saybolt viscometers - continuous measurement of viscosity - rotameter for viscosity measurement.

FOR FURTHER READING

Case studies on industrial measurement - data sheet for industrial sensors/transducers

Total: 45 Hours

Reference(s)

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi,2011.
2. K.Krishnaswamy and S.Vijayachitra, Industrial Instrumentation, New age International Private limited, 2010.
3. R. K. Jain, Mechanical & Industrial Measurements, Khanna publishers, New Delhi, 2008.
4. K. Sawhney and P. Sawhney, A Course on Mechanical Measurement and Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2001.
5. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, New Delhi, 2006.
6. B. G. Liptak, Instrument Engineers Hand Book (Measurement), Chilton Book Co, New York 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					7				5								4							18
2		2				11				6				2											21
3	2					6	6			2				4											20
4		4				10				4				2											20
5	2	2				10				2				5											21
																								Total	100

Assessment Questions
Remember

1. Recall the type of transmitter and receiver used in ultrasonic level gauge.
2. Name any two positive displacement type flow meters.
3. State any four methods to measure boiler drum level.
4. Classify the ultrasonic type flow meters.
5. List any four materials for fabricating orifice meter.
6. Name any four properties of fluid.
7. Define the term viscosity index.
8. Define venacontracta in orifice flow meter.
9. Classify the inferential type flow meters.
10. Classify the measurement schemes used for boiler drum level measurement.
11. Define discharge co-efficient.
12. State the karman‘s principle.
13. Define Laser Doppler Effect.
14. Name four type of variable area flow meters.

Understand

1. Indicate any two demerits of electromagnetic flow meter.
2. Give any two examples for moisture measurement process.
3. Sketch the schematic of inferential flow meter and explain its operation along with applications, merits and demerits.
4. Examine the installation process of Rotameter.
5. Explain the features of vortex shedding flow meter.
6. Generalize the factors to be considered before drawing up specifications for a flow meter and examine the factors in detail.
7. Explain the working principle of displacer type level gauge.
8. Explain the visual indicator and float type level measurement schemes.
9. Generalize procedure to measure level using ultrasonic sensor.
10. Explain the capacitive and resistive type level measurement schemes with necessary sketch.
11. Illustrate the working principle of dry and wet bulb psychrometer.
12. Summarize the procedure to measure viscosity using rotating cylinder method.
13. Explain the different schemes of moisture measurement.
14. Estimate the reason for up-down movement of a float in a liquid.
15. Illustrate the operation of Coriolis flow meter.
16. Explain the operation of reciprocating piston meter with suitable sketch.
17. Summarize the procedure to measure humidity using hygrometers.
18. Illustrate the operation of Saybolt viscometer.

Apply

1. Produce the characteristic of the two tubes in Coriolis flow meter, when the flow changes from minimum to maximum.
2. A pitot tube mounted on an aircraft is connected to a pressure gauge which reads a pressure of 10 kN/m2. Calculate the flying speed of the aircraft. Density of air at that height can be taken as 1.2 kg/m3.
3. A Rotameter uses a cylindrical float of 3.5 cm height, 3.5 cm diameter and density of 3900 kg/m3. The maximum inside diameter of the metering tube is 5 cm and discharge coefficient Cd = 0.6. Calculate the maximum flow rate handling capacity of the rotameter if the fluid is water.
4. Calculate the induced emf in an electromagnetic flow meter due to the flow of a conductive fluid in a pipe with inner diameter of 3 cm. The flux density B = 6 mV.sec/cm2 and volume flow rate Q = 2600 cm3/min.

5. Calculate the velocity of flow in an electromagnetic flow meter for the following conditions. The flux density in the liquid has an average value of 0.1 Weber/m2. The diameter of the pipe is 20 cm. The induced voltage of the electromagnetic flow meter is recorded as 1 mV.
6. Use due point to specify humidity.
7. Calculate the pressure difference at the taping and nominal flow velocity V2 at the orifice having a diameter of 30 mm kept in a pipe of 50 mm diameter. Reynolds number R*a* is 105. Assume density of water = 1000 kg/m3, discharge coefficient Cd=0.6 and kinematic viscosity is 10–2 cm2/sec.
8. A venturi tube of throat diameter 15 cm is placed in a pipe of diameter 30 cm to measure the volumetric flow. The volumetric flow rate through venturi tube is 0.03 m3/sec. Water has the viscosity of 10–3 Pas. venturi tube has a discharge coefficient of 0.98 and Z=1. Calculate the Reynolds number and differential pressure developed between upstream and throat.
9. Use bubbler tube for level measurement and explain its operation.
10. Apply hydrostatic pressure method for measurement of level and explain the measurement process.

Analyse

1. Point out the need for sealing and condensation pots while mounting the head type flow meters.
2. Compare absolute humidity and specific humidity.
3. Identify a method to reduce pressure loss in over sized rotameters.
4. Compare open and closed tank level measurement techniques.
5. Distinguish between moisture and humidity.
6. Analyze the guidelines for flow meter selection.
7. Compare the excitation schemes used in electromagnetic flow meter.
8. Analyze the application details of various flow meters.
9. Compare the gravimetric feeder based solid flow measurement schemes.

Create

1. Design a signal conditioning circuit for electrical method of pressure measurement.
2. Select a flowmeter for a realtime applications based the given constraints.

15EI604 DIGITAL SIGNAL PROCESSING 3 2 0 4

Course Objectives

- To execute the Z transform and Discrete Fourier Transform (DFT) for a given signal / system.
- To design the digital filters and realize the digital filters by different structures.
- To understand the architecture and features of the digital signal processor.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Apply the mathematical concepts to investigate the discrete time signals and systems.
2. Apply the Z transform and Discrete Fourier Transform for a given signal / system.
3. Design the digital filters and analyze the amplitude and phase response of FIR filters.
4. Implement and analyze issues of discrete time systems.
5. Develop simple programs in ADSP for specific applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1		2										
2	3	1		2										
3	1	2	3											2
4	1	3	2											2
5			3	2	3							2		2

UNIT I **8 Hours**

SIGNALS AND SYSTEMS

Basic elements of digital signal processing - concepts of frequency in analog and digital signals - classification of discrete time signals - classification of discrete time systems - mathematical representation of signals - sampling and reconstruction of continuous time signals.

UNIT II **11 Hours**

TRANSFORMATIONS

Z transform - properties - inverse Z transform - solution of difference equations by Z transform; Discrete Fourier Transform (DFT) - properties - Efficient computation of DFT: radix-2 Fast Fourier Transform (FFT) algorithms in Decimation in Time (DIT) & Decimation in Frequency (DIF) - correlation techniques.

UNIT III **11 Hours**

DIGITAL FILTER DESIGN

Finite Impulse Response (FIR) design: Amplitude and phase responses of FIR filter - Linear phase characteristics - Need and choice of windows - Windowing Techniques: Rectangular, Hamming and Hanning; Infinite Impulse Response (IIR) design: Design of digital low pass Filter - Butterworth, Chebyshev filter - impulse invariant and bilinear transformation - Frequency transformation.

UNIT IV **8 Hours**

IMPLEMENTATION OF DISCRETE TIME SYSTEMS

Structure for FIR systems: Direct, cascade, frequency sampling, Lattice; Structure for IIR System: Direct, cascade and parallel; Finite word Length Effects: Representation of numbers - Quantization of filter coefficients - round-off effects in digital filters.

UNIT V **7 Hours**

DIGITAL SIGNAL PROCESSORS

Introduction to DSPs - Architecture, Assembly Language Instructions, Instruction Pipelining and simple programs in ADSP.

FOR FURTHER READING

DFT based Dual-Tone Multi-Frequency (DTMF) detection algorithm - analysis of speech signals using STFT (Short-Time Fourier Transform) - Power Spectrum estimation using an AR model by FIR / IIR digital filter - Time domain operations in Musical Sound Processing by FIR / IIR digital filter.

Total: 75 Hours

Reference(s)

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications, Pearson Education, New Delhi, 2013.
2. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, Discrete - Time Signal Processing, Pearson Education, New Delhi, 2013.
3. S. Salivahanan, C. Gnanapriya, Digital Signal Processing, Tata McGraw Hill Education Private Ltd, New Delhi, 2010.
4. P. Ramesh Babu, Digital Signal Processing, Scitech Publications (India) Pvt Limited, 2012.
5. S. K. Mitra, Digital Signal Processing - A Computer Based Approach, Tata McGraw Hill, New Delhi, 2012

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1			2	2				2				12											20
2		1			1	2				4	12														20
3		1				1	2			4	12														20
4		2					2			4													12		20
5	1	1			4	12																2			20
																								Total	100

Assessment Questions

Remember

1. State the aliasing effect.
2. Define energy signal and power signal.
3. State Parseval's relation in Z – transform.
4. Define the ROC of the Z – transform.
5. State the any two features of IIR filters.
6. List the any two properties of Chebychev filter.

7. List the any two properties of Butterworth filter.
8. List the different stages of pipelining.
9. List the features of PDSP over advanced microprocessor.

Understand

1. Illustrate the sample and hold circuit.
2. Illustrate the 4-point radix-2 DIT-FFT algorithm.
3. Compare linear and circular convolution.
4. Illustrate the basic butterfly diagram / flow graph of radix-2 DIT-FFT.
5. Compare the frequency response of Chebychev type-I and type-II filters.
6. Identify the suitable addressing mode for FFT computation, and Justify the answer.
7. Explain the internal architecture of ADSP.
8. Explain the pipeline operation with call and branch instructions.
9. Explain the opearion of sampling and reconstruction of an analog signals.
10. Exemplify the immediate and direct addressing modes.

Apply

1. The z-transform X[z] of a sequence x[n] is given by X[z]= 0.5/(1-2z^(-1)) and it is given that the region of convergence of X[z] includes a unit circle. compute the initial value of the system.
2. Compute the 8-point DFT of the sequence x(n)=n+1 using the radix-2 decimation-in- frequency algorithm.
3. Compute an 8-point DFT of the following sequence using DIF-FFT algorithm.
   x(n)={0, 1, 2, 3, 4, 5, 6, 7}
4. Execute the radix-2 decimation-in-frequency FFT algorithm for N=8 and draw the corresponding signal flow graphs.
5. Compute the order of the filter of low pass Butterworth filter that has a 3dB attenuation at 500 Hz and an attenuation of 40 dB at 1000 Hz.
6. Realize y(n)+y(n-1)+0.25y(n-2)=x(n) in cascade form network.
7. The transfer function of a system is given by H(Z) = (1+Z^-1+Z^-2) / (1+ 1/2 Z^-1) (1+1/6Z^-1). Construct the system in parallel structure.
8. Develop a program to calculate the value of the function Y=A*X+B*Y+C*Z.
9. The specifications of the desired low pass filter is
   0.8<|H(e^jw)|<1.0 for 0
   |H(e^jw)|<0.2 for 0.6pi
   Design a digital Butterworth digital filter using impulse invariant transformation

Evaluate

1. Determine the condition for the stability of the following system, h(n)=a^n u(n).
2. Determine the stability and causality for the discrete LTI system is represented by impulse response h[n]=(1/2)^n u[n].
3. Determine the stability and causality for the impulse response h[n] of the LTI system is h[n]=u[n+3]+u[n-2]-2u[n-7].
4. Determine whether the following system is time invariant y(n) = x(n/2).
5. Determine whether the following system is linear or non-linear.
   y(n) = 2 x(n) + 1/(x(n-1))
6. Determine whether the following system is stable or unstable.
   h(n) = (½)^n u(n)
7. Determine whether the following filter is (i) Linear (ii) Stable (iii) Time-invariance (iv) Causality
   y(n) = 2 x(n+1) + (x(n-1)) ^2
8. Determine whether the following systems are (i) Linear (ii) Static (iii) Time-invariance (iv) Causality.

(i) $y(n) = |x(n)|$
(ii) $y(n) = 2\,x(n+2) - x(n-2)$

9. Determine whether the following signals are energy or power or neither energy nor power signals.
   (i) x(n) = (½)^n u(n)
   (ii) x(n) = sin((pi/3)*n)

Create

1. Derive the frequency response of linear phase FIR filters for symmetrical impulse response when N is odd and even.
2. Derive the frequency response of linear phase FIR filters for anti-symmetrical impulse response when N is odd and even.

15EI607 PROCESS CONTROL LABORATORY 0 0 2 1

Course Objectives

- To acquire knowledge about the functionality of field instruments and controllers.
- To gain the programming knowledge in virtual instrumentation for process control.
- To design and implementation of controllers for different processes.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Demonstrate final control element, converter and transmitter in real time.
2. Compute an open loop response for a level control process.
3. Determine a closed loop response for temperature, pressure and flow process station.
4. Design ON/OFF controller for a given system.
5. Attribute PID tuning parameters and implement advanced control schemes for level and pressure process.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2						1				3	
2	1	1	2	2	3				1					3
3	2	3	3	3	2				1					3
4	2	3	3	3	2				1					3
5	1	1	2	3	2				1					3

1 **2 Hours**

EXPERIMENT 1
Convertion of current into Pressure and Pressure into Current using appropriate field instruments.

2 **4 Hours**

EXPERIMENT 2
Open loop response of interacting and non interacting level process.

3 **3 Hours**

EXPERIMENT 3
Analyze the response of different types of control valves.

4 **3 Hours**

EXPERIMENT 4
Tuning of PID controller for a given system.

5 **3 Hours**

EXPERIMENT 5
Closed loop control of flow process with and without transportation lag.

6 **3 Hours**

EXPERIMENT 6
Closed loop control of temperature process station.

7 **3 Hours**

EXPERIMENT 7
Closed loop control of pressure process.

8 **3 Hours**

EXPERIMENT 8
Design of on/off controller for a system.

9 **3 Hours**

EXPERIMENT 9

Implementation of cascade control scheme for level process.

10 **3 Hours**

EXPERIMENT 10

Implementation of single loop PID controller for a given Process.

Total: 30 Hours

15EI608 INDUSTRIAL INSTRUMENTATION LABORATORY 0 0 2 1

Course Objectives

- To strengthen knowledge in measurements of flow, torque and humidity using various transducers
- To calibrate the pressure transducers using different standards
- To design of compensation and linearization circuit for temperature transducers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Demonstrate the orifice meter, Venturi meter, Mass flow meter, DPT setup for measuring flow rate and Level
2. Demonstrate the PH meter, Conductivity meter, Strain gauge, Pressure gauge and Hygrometer for measuring PH, Conductivity, Torque, Vacuum and Humidity
3. Compare the pressure gauge and DPT using standard instruments
4. Design the linearization and compensation circuit for thermocouple
5. Integrate the field instruments with controller

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2					1				3	2
2	1	3	2	2					1				3	2
3	1	2	3	3					1				3	2
4	1	2	2	3					1				3	2
5	1	3	3	2					1				2	3

1 **3 Hours**

EXPERIMENT 1

Measurement of flow rate using Orifice meter, Venturi meter and mass flow meters

2 **3 Hours**

EXPERIMENT 2

Calibration of pressure gauge using Dead weight tester.

3 **3 Hours**

EXPERIMENT 3

Torque measurement using strain gauge

4 **6 Hours**

EXPERIMENT 4

Interfacing of field instruments with controller.

5 **3 Hours**

EXPERIMENT 5

Measurement of humidity and vacuum

6 **6 Hours**

EXPERIMENT 6

Level measurement using Differential pressure transducers

7 **3 Hours**

EXPERIMENT 7

pH measurement and conductivity measurement.

8 **6 Hours**

EXPERIMENT 8

Design of cold Junction compensation circuit for Thermocouple

9 **6 Hours**

EXPERIMENT 9

Linearization of Thermocouple

10 **6 Hours**

EXPERIMENT 10

Calibration of Differential pressure transducers using HART communicator

Total: 45 Hours

Text Book(s)

1. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi,2011.
2. K.Krishnaswamy and S.Vijayachitra, Industrial Instrumentation, New age International Private limited, 2010

Reference(s)

1. R. K. Jain, Mechanical & Industrial Measurements, Khanna publishers, New Delhi, 2008
2. K. Sawhney and P. Sawhney, A Course on Mechanical Measurement and Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2001.
3. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, New Delhi, 2006.
4. B. G. Liptak, Instrument Engineers Hand Book (Measurement), Chilton Book Co, New York 2012.

15EI609 TECHNICAL SEMINAR II 0 0 2 1

Course Objectives

- To develop self-learning skills of utilizing various technical resources to make a technical presentation
- To promote the technical presentation and communication skills
- To impart the knowledge on intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds
- To promote the ablility for Interacting and sharing attitude
- To engarauge the commitment-attitude to complete tasks

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple fields
2. Improve the technical presentation and communication skills
3. Analyze the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.
4. Interact and share their technical knowledge to enhance the leadership skills
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			1		1	1		1	2	3		2		
2			1		1	1		1	2	3		2		
3			3		3	3		3	2	3		2		
4			1		1	1		1	2	3		2		
5			1		1	1		1	2	3		2		

Total: 0 Hours

15EI610 MINI PROJECT IV 0 0 2 1

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the Ã‚Â project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness. effectiveness
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	1	2	2	3	3	2	3	3	3	3
2	2	2	3	2	3	1	2	3	3	1	3	3	3	3
3	2	2	3	2	3	1	2	2	3	1	2	3	3	3
4	2	2	3	2	3	3	2	3	3	3	3	3	3	3
5	2	2	3	1	3	1	2	2	3	3	2	3	3	3

Total: 0 Hours

15GE611 LIFE SKILLS: APTITUDE II 0 0 2 0

Course Objectives

- The undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Perform arithmetical operations with complex numbers
2. Explain the meanings of a relation defined on a set, an equivalent relation and a partition of a set
3. Calculate percentages in real life contexts , find any percentage of a given whole using their knowledge of fraction multiplication and increase / decrease a given whole by a percentage
4. Demonstrate the situations like motion in as straight line, Boats and Streams, Trains, Races and clocks
5. Evaluate the Counting techniques, Permutation and Combination, Recursion and generating functions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				2	1							
2	3	2				2	1							
3	3	2				2	1							
4	3	2				2	1							
5	3	2				2	1							

1 **3 Hours**

NUMBER SYSTEMS

Introduction - definition- classification on Numbers -power cycles and remainders - short cut process - concept of highest common factor - concept of least common multiple - divisibility - number of zeros in an expression

2 **3 Hours**

PERCENTAGES

Introduction - definition and Utility of percentage - importance of base/denominator for percentage calculations - concept of percentage values through additions - fraction to percentage conversion table

3 **3 Hours**

AVERAGES

Introduction - average of different groups - addition or removal of items and change in average-replacement of some of the items

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- properties-dividing a given number in the given ratio - comparison of ratios - proportions - useful results on proportion- continued proportion - relation among the quantities more than two – variation

5 **3 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-multiplying equivalents to find sale price - relation among cost price, sale price, gain/loss and percentage gain or percentage loss - an article sold at two different selling price - two different articles sold at same selling price - percentage gain or percentage loss on selling price - percentage gain or percentage loss on whole property

6 **3 Hours**

TIME AND WORK

Introduction - Basic concepts -Concepts on working with different efficiency - Pipes and Cisterns - Work Equivalence (Man Days) -Alternative approach

7 **3 Hours**

TIME, SPEED AND DISTANCE

Definition - Basics of Time, Speed and Distance - Relative speed - Problems based on Trains? Problems based on Boats and Streams -Problems based on Races - time taken with two difference modes of transport - time and distance between two moving bodies

8 **3 Hours**

PERMUTATION AND COMBINATION

Definition - Fundamental rules - Theorems on Permutation - Theorems on Combination

9 **3 Hours**

PROBABILITY

Concept and importance of probability - underlying factors for Real- Life estimation of probability - Basic facts about probability - some important consideration while defining event.

10 **3 Hours**

MIXTURES AND ALLIGATION

Definition - alligation rule - mean value (cost price) of the mixture - some typical situations where allegation can be used.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
3. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
4. Edgar Thorpe , Course In Mental Ability And Quantitative Aptitude For Competitive Examinations, Third Edition, Tata McGraw-Hill Publishing Company Ltd, 2013
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

15GE601 PROFESSIONAL ETHICS 2 0 0 2

Course Objectives

- To understand Human values, ethical theory, codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues
- To understand personal ethics, legal ethics, cultural associated ethics and engineer's responsibility

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Explain the human values.
2. Implement the importance of ethics and professionalism.
3. Illustrate the effect of social experimentation.
4. Identify the workplace responsibilities and uphold right issues
5. Construct duties pertaining to global issues.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3			2			
2								2			2			
3											3			
4								2			2			
5								2			2			

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of 'Engineering Ethics'- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlberg's and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse - Sample codes NSPE - IEEE - Institution of Engineers (India).

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl case studies - Fundamental Rights, Responsibilities and Duties of Indian Citizens -Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	5	5				5					5														20
2		5			5						5										5				20
3		5					10				5														20
4	5									5											5	5			20
5	5					5				5					5										20
Total																									100

Assessment Questions

Remember

1. Define Human Values.
2. What are Morals and Values?
3. What do you mean by Civic virtue and Respect for others?
4. Write the various meanings of ???Spirituality?
5. List four different types of Virtues.
6. Mention different Human values.
7. Classify the types of inquiry
8. What are the steps needed in confronting moral dilemmas?
9. List the levels of moral development suggested by Kohlberg
10. What do you understand by self-interest and ethical egoism?
11. What are the steps needed in confronting moral dilemmas?
12. What are the three virtues of religion?

Understand

1. Which are the practical skills that will help to produce effective independent thought about moral issues?
2. Why does engineering have to be viewed as an experimental process?
3. Why isn‘t engineering possible to follow a random selection in product design?
4. Why is the code of ethics important for engineers in their profession?
5. What does the Balanced Outlook on Law stress in directing engineering practice?
6. Are the engineers responsible to educate the public for safe operation of the equipment? How?

7. Why is Environmental Ethics so important to create environmental awareness to the general public?
8. Why do the engineers refuse to do war works sometimes?

Apply

1. How does the consideration of engineering as a social experimentation help to keep a sense of autonomous participation is a person's work?
2. How does the code of ethics provide discipline among the engineers?
3. Exemplify the space shuttle Challenger case accident?
4. How does the manufacturer understand the risk in a product catalog or manual?
5. How does the knowledge of uncertainties in design help the engineers to access the risk of a product?
6. How can the quantifiable losses in social welfare resulting from a fatality be estimated? Give some examples.
7. How does the engineer act to safeguard the public from risk?

15EI702 ANALYTICAL INSTRUMENTS 3 0 0 3

Course Objectives

- To understand the various techniques and methods of analysis that occurs in the various regions of the spectrum
- To impart an adequate knowledge about chromatography method for analysis of industrial gases
- To understand the concepts of interaction of electromagnetic radiation with matter.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Summarize the basic principle of colorimeter and two types of optical instruments
2. Differentiate the chromatographic techniques used for industrial applications
3. Select specific techniques employed for analyzing gas, dissolved component and monitoring different pollutants in air and water
4. Outline the detection of silicon, sodium and dissolved oxygen using three different electrodes and analyzers
5. Choose the appropriate radiation techniques (NMR, ESR, and EPR) to determine the elements present in the sample

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3		2								1	1
2	1	2	3		2								1	2
3	2	2	3	1									1	3
4	2	3	2	1	1								2	3
5	3	3	3	3	2								2	2

UNIT I **9 Hours**

COLORIMETRY AND SPECTROPHOTOMETRY

Beer-Lambert's law - colorimeters - basic principle of spectroscopy -Emission and absorption of radiation sources - UV and visible spectrophotometers - single and double beam instruments - sources and detectors - IR spectrophotometers - attenuated total reflectance flame photometers - atomic absorption spectrophotometers - sources and detectors - FTIR spectrophotometers - flame emission photometers.

UNIT II **7 Hours**

CHROMATOGRAPHY

Different techniques - Gas chromatography - Detectors - Liquid chromatography - Applications - High - pressure liquid chromatography - Applications.

UNIT III **10 Hours**

GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS

Gas analyzer : oxygen, NOx and H2S types, IR analyzers, thermal conductivity analyzers - air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides and sulphur dioxide estimation - dust and smoke measurements.

UNIT IV **9 Hours**

PH CONDUCTIVITY AND DISSOLVED COMPONENT ANALYZER

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes - dissolved oxygen analyzer - sodium analyzer - silicon analyzer

UNIT V **10 Hours**

NUCLEAR MAGNETIC RESONANCE AND RADIATION TECHNIQUES

Nuclear radiation - microwave spectroscopy - NMR, ESR and EPR spectroscopy - applications - mass spectrophotometers - nuclear radiation detectors - GM counter - proportional counter - solid state detectors - X-ray spectroscopy - detectors - diffractometers - absorption meters - detectors

FOR FURTHER READING

Atomic Fluorescence Spectroscopy, Role of Analytical Instruments in Biomedical Instrumentation, Methods for Moisture and water content determinations, Paper chromatography column for separation of ink and water.

Total: 45 Hours

Reference(s)

1. Willard, H.H., L. L. Merrit, J. A. Dean and F. L. Seattle, Instrumental Methods of Analysis, CBS Publishing Co, New York,2010
2. G. W. Ewing , Instrumental Methods of Analysis, McGraw Hill book Co, New York, 2009
3. Robert D. Braun, Introduction to Instrumental Analysis, Pharma Book Syndicate, 2008
4. D. A. Skoog and D. M. West , Principles of Instrumental Analysis, Holt Sounder Publication, Philadelphia, 2007
5. Robert D. Braun, Introduction to Instrumental Analysis, McGraw Hill book Co, New York, 2006

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			2	4																			14
2	2				2	4				2				2				2	2			6			22
3	2				2					2				6	3							6			21
4		2			2					2				6	3							6			21
5		4				4				6								4				4			22
																								Total	100

Assessment Questions

Remember

1. Define Beer Lambert's law.
2. State transmittance.
3. List the main parts of pH measurement system
4. Define pH value.
5. Define column chromatography.
6. Label the types of mass analyzer
7. Recall the use of chromatograms.
8. List the four disadvantages of liquid chromatography
9. Recall the term open tubular column.
10. Define the term "efficiency of a chromatography".

Understand

1. Indicate the advantages of Fourier Transform Spectrometers.
2. Illustrate the techniques used for handling solid samples in IR spectroscopy.
3. Illustrate the detectors and burners used in atomic absorption spectroscopy.
4. Explain the applications and advantages of liquid chromatography.
5. List the types of detectors used in gas chromatography and explain any two of them.
6. Summarize the function of Hay's Magnetostrictive analyzer used for measurement of oxygen in stream of gas.
7. Indicate the advantages of Fourier Transform Spectrometer.
8. Illustrate the detectors and burners used in atomic absorption spectroscopy.
9. With a neat schematic diagram, discuss the separation principle of HPLC (High Pressure Liquid Chromatography).

Apply

1. Show the detection of smoke in Ionization smoke detector.
2. An open tubular column having the bore of 0.18mm and the length is 700cm, the mobile phase is moving at a velocity of 35cm/sec. The retention time trof the solute is 1.22 min peak width at half height is 0.75sec. Calculate
   (a) Retention time of non-retained compound
   (b) Capacity factor
   Number of plates
   (d) Plate height
3. An open tubular column having the bore of 0.18mm and the length is 700cm, the mobile phase is moving at a velocity of 35cm/sec. The retention time trof the solute is 1.22 min peak width at half height is 0.75sec. Compute
   (a) Retention time of non -retained compound
   (b) Capacity factor
   Number of plates
   (d) Plate height
4. Implement the Beer‘s law for energy absorption and concentration
5. Show the detection of smoke in Ionization smoke detector.
6. Implement the intensity of radioactive radiation measured in GM and proportional counters
7. Execute the Flame Ionization and Electron Capture detectors in gas chromatography.
8. Implement the requirements of HPLC pumping system and discuss the advantages and disadvantages of it.
9. Compute the relationship between the energy absorption and concentration and discuss the reasons for deviations of Beer’s law.
10. Implement the chromotography for testing the trace quantity of pesticides in groundwater.

Analyse

1. Compare the relationships between the retention time, retention volume and retention factor.
2. Analyze the efficiency of the sodium analyzer and silica analyzer.
3. Justify hydrogen electrode is used as a primary reference electrode
4. Outline the working of gas chromatography with necessary diagrams.
5. List the basic components available in HPLC and explain about the sample injection system & liquid chromatographic column in GC.
6. Outline the working of high pressure liquid chromatography with necessary diagram.
7. Point out the instrumentation of UV Spectrophotometer and explain with its diagrams.
8. Point out the uses of bolometer in spectroscopy.
9. Compare gas and liquid chromotography.

Evaluate

1. Substances A and B having the peak widths at base for A and B were 1.21 and 1.32 minutes respectively. The retention times are found to be 16.86 and 18.28 minutes respectively on a 40.0cm column. An unretained species passed through the column in 1.15 minutes. Detect the i) average number of plates, ii) Plate height, iii) column resolution, iv) Linear mobile phase and solutes velocity, v) Adjusted retention times of two solute.

Create

1. Design the different types of electrodes used for the determination of pH and conductivity.
2. Design the different types of electrodes used for the determination of pH and conductivity.

15EI703 INDUSTRIAL AUTOMATION 3 2 0 4

Course Objectives

- To understand the fundamentals of Programmable Logic Controller(PLC), Supervisory Control and Data Acquisition (SCADA) and Distributed Control System (DCS)
- To program and configure the advanced controller for a given application
- To familiarize the functions of different communication protocols

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Interpret the architecture and concepts of PLC program
2. Execute PLC and Supervisory Control and Data Acquisition (SCADA) for various applications
3. Examine the concepts of Distributed Control System
4. Analyze the interfacing methods in DCS
5. Implement the communication protocol for given application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	2										
2	2	2	3	2	3									
3	1	2	2	2										
4	1	2	3	2										
5	1	2	3	2										

UNIT I **9 Hours**

PROGRAMMABLE LOGIC CONTROLLER

Evolution of PLCs- Components of PLC - Architecture of PLC - Discrete and analog I/O modules - Programming languages -- Ladder diagram - Function block diagram (FBD) - Programming timers and Counters

UNIT II **8 Hours**

PLC SCADA AND ITS APPLICATIONS

Instructions in PLC - Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions - Case studies in PLC. Introduction to SCADA - components of SCADA - features of SCADA

UNIT III **8 Hours**

DISTRIBUTED CONTROL SYSTEM

DCS - Various Architectures - Comparison - Local control unit - Process interfacing issues

UNIT IV **10 Hours**

INTERFACES IN DCS

Operator interfaces - Low level and high level operator interfaces - Displays - Engineering interfaces - Low level and high level engineering interfaces - Factors to be considered in selecting DCS - Case studies in DCS

UNIT V **10 Hours**

COMMUNICATION PROTOCOLS

Introduction to communication protocols- TCP/IP protocol - HART communicator protocol - Media access Protocol- Data link control protocol - PROFI bus - Mod bus - CAN bus- Field bus: General Field bus architecture, Field bus standard, Field bus topology - interoperability - interchangeability

FOR FURTHER READING

Local Area Network - Wireless communication (Ipv6, Ipv4)- Programmable Automation Controller - CAN bus - Analog I/O configuration in PLC programming

Total: 75 Hours

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India,2012
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes/Elsevier, 2013
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2011
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013
6. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1985

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	2			1	6				2	6														18
2	2	1			1	2					6			2					6						20
3	1	1			1	2			1		6				6										18
4		2			2		6		2		6				6										24
5	1			1			4			6			2						6						20
																								Total	100

Assessment Questions

Remember

1. Define Programmable Logic Controller as per ISA standard.
2. List four types of number system used in PLC.
3. List four types of programming languages used in PLC.
4. Draw timing diagram of "On delay timer".
5. Draw architecture of Programmable Logic Controller
6. Draw architecture of Programmable Logic Controller.
7. Draw architecture of Programmable Logic Controller.
8. List four program control instruction used in PLC.
9. Recall the merits of shift register instruction in PLC.
10. List the four parameters in sequence output compare instruction.
11. Define SCADA.
12. List four major components in SCADA.
13. List four major process interfacing issues in DCS.
14. Draw architecture of DCS.
15. List the component of Local Control Unit.
16. Draw the heirarchy of display used in DCS.
17. Recall the two major features of operating interface.
18. Recall the two major features of engineering interface.
19. List the four major factors to be considered while a selecting a DCS.
20. DrawÂ Media Access Control in encapsulation of a packet of data.
21. List the two limitations of Profibus.
22. Draw strucutre of HART message.
23. Recall the necessary for interchangeability.
24. List two types of FOUNDATION field bus.
25. Define TCP / IP protocol.

Understand

1. Intrepret the function of opto isolator.
2. Exemplify working of Analog and Digital Input / Output module in PLC
3. Illustrate relay diagram used in the industrial automation.
4. Infer the operation of Timer instruction used in PLC.
5. Compare the function of Up Counter and Down Counter instruction in PLC.
6. Draw the architecture and explain the function of SCADA.
7. Indicate the salient features of SCADA when compared to DCS and PLC.
8. Explain the shift register instruction with an example.
9. Compare function of Local Control Unit A, B and C type.
10. Explain the architecture evolution of Distributed Control System.
11. Exemplify the function of two major process interfacing issues in DCS
12. Indicate the salient features of hybrid architecture in DCS
13. Interpret the important function of Local control unit in DCS during emergency situation.
14. Exemplify the architecture of Distributed Control System.
15. Indicate the salient features of high level operating interface in DCS.
16. Interpret the function of high level engineering interface.
17. Indicate the factors to be considered while selecting a DCS.
18. Explain the general field bus architecture .
19. Interpret the need of TCP / IP protocol.
20. Explain interoperability and interchangeability.

Apply

1. Two part conveyor lines, A and B. feed a main conveyor line M. A third conveyor line R, removes rejected parts a short distance away from the main conveyor. Conveyors A, B, and R have parts counters connected to them. Construct a PLC program to obtain the total parts output of main conveyor M.
2. A main conveyor has two conveyors, A and B, feeding it. Feeder conveyor A puts six-packs canned soda on the main conveyor, Feeder conveyor B puts eight-packs of canned soda on the main conveyor. Both feeder conveyors have counters that count the number of packs leaving them. Construct a PLC program to give a total can count on the main conveyor.
3. Design a program that will take the accumulated value from TON timer T4:1 and display it on a 4-digit. BCD format set of LEOs. Use address O:023 for the LEOs. Include the provision to change the preset value of the timer from a set of 4-digit BCD thumbwheels when input A is true. Use address I:012 for the thumbwheels.
4. Construct a non retentive timer program that will turn on a pilot light after a time-delay period. Use a thumbwheel switch to vary the preset time-delay value of the timer.
5. Assume that a thermocouple is connected to an analog input module of Distributed Control System. Explain how the temperature of the thermocouple is communicated to the processor.
6. The MOV instruction will be used to copy the information stored in word N7:20 to N7:35. Find the address should be entered into the source and destination?
7. When programming stop buttons, why is Â it safer to use an NC button programmed to examine for an on condition than an NO button programmed to examine for an off condition?
8. For a known TCPIIP network determine how the DNS is implemented and how IP addresses are granted.
9. Asses how Fieldbus will change the operation of a large instrumentation network. Outline the functions that are likely to be controlled by the DCS and which are likely to be controlled locally, in the field.
10. Show HART protocol function is based on OSI standard.

Analyse

1. Compare Programmable Logic Controller, Distributed Control system and Supervisory Control and Data Aquisition with important parameters.
2. Compare the architecture of HART, Fieldbus with OSI standard.
3. When programming a motor starter circuit, Justify why is it safer to use the starter seal·in auxiliary contact in place of a programmed contact referenced to the output coil instruction?
4. Differentiate Fixed, Flexible and Programmable automation.
5. Compare Remote Terminal Unit in SCADA and PLC in industrial automation.
6. In a continuous process control, to have effective PID control implementation, Distributed Control System will be a better option than Programmable Logic Controller. Justify the statement.
7. Compare On delay timer and OFF delay timer with an example
8. Differntiate Up counter and Down Co
9. Compare relay diagram and ladder logic diagram used in PLC.

Create

1. Devise a ladder program that could be used to operate the simplified task shown in Figure for the automatic drilling of work pieces. The drill motor and the pump for the air pressure for the pneumatic valves must be started. The work piece has to be clamped. The drill then must be lowered and drilling must be started to the required depth. Then the drill has to be retracted and the work piece unclamped. This cycle is to be repeated for 10 times.
2. A traffic light controller is to be designed for a road, partially closed to traffic for urgent repair work (Fig.1). North traffic light will go GREEN for 30 sec with South traffic light giving RED

signal. For the next 15 sec, both the traffic lights will be give RED signals. Thereafter South traffic light will go GREEN for 30 seconds with North traffic light giving RED signal. Both the traffic lights will give RED signal for the next 15 sec. Then this cycle repeats. Develop a PLC ladder diagram that accomplishes this objective.

15EI704 BIOMEDICAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To understand the role of instrumentation in bio medical engineering field
- To get ample knowledge on Electro-physiological and non-electric parameter measurement
- To analyze parameters of medical imaging and its measurements

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Analyze about human physiology and bio potential electrodes
2. Interpret the electro-physiological and blood flow measurement techniques
3. Implement different sensors for non - electrical parameter measurements
4. Relate the concepts of different types of medical imaging techniques
5. Infer various applications for therapeutic and assisting devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	2	1	1	1					2		
2	3	2	3	2	3	1	1	1				2		
3	3	3	3	2	3	1	1	1				2		
4	3	2	1	3	3	1	1	1				2		
5	3	2	1	1	3	1	1	1				2		

UNIT I **10 Hours**

HUMAN PHYSIOLOGY AND BIO POTENTIAL ELECTRODES

Cell and their structures - action and resting potential - nervous system: functional organisation of the nervous system, structure of nervous system, neurons, synapse - transmitters and neural communication - cardiovascular system - basic components of a biomedical system - different types of electrodes - electrical safety - grounding and isolation

UNIT II **9 Hours**

ELECTRO - PHYSIOLOGICAL AND BLOOD FLOW MEASUREMENT

ECG - EEG - lead system and recording methods - typical waveforms - Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT III **9 Hours**

NON - ELECTRICAL PARAMETER MEASUREMENT

Measurement of blood pressure -Heart rate - Heart sound -Pulmonary function measurements - spirometer - Body Plethysmograph - Blood Gas analyzers : pH of blood - measurement of blood pCO_2, pO_2, pulse oximeter

UNIT IV **9 Hours**

MEDICAL IMAGING PARAMETER MEASUREMENTS

X- RAY machine - Computer Tomography - Magnetic Resonance Imaging system - ultra sonography - Endoscopy - bio-telemetry

UNIT V **8 Hours**

ASSISTING AND THERAPEUTIC DEVICES

Cardiac pacemakers - defibrillators - ventilators - heart lung machine - dialysers - elements of audio and visual Aids

FOR FURTHER READING

Biosensors - glucose and drug detection, biomechanics - limb prosthetics - orthotics

Total: 45 Hours

Text Book(s)

1. R.S.Khandpur, Hand Book of Bio-Medical instrumentation, Tata McGraw Hill publishing company Ltd., 2014

Reference(s)

1. J.G. Webster, Medical Instrumentation: Application and Design, John Wiley and Sons, New York, 2010
2. Leslie Cromwell, Biomedical Instrumentation and measurement, Tata McGraw Hill, 2007
3. G. Well, Biomedical Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	4				4				5								5							20
2		4				4				6				6											20
3	2	2				4				6				6											20
4		2				4				6												8			20
5	2	4				6			2	6															20
																								Total	100

Assessment Questions

Remember

1. Define depolarization of a cell.
2. State the principle fluid medium in cell.
3. Recall the principle ions responsible for action potential.
4. List the electrodes that have high input impedance.
5. List the characteristics of ECG preamplifier.
6. List out the important parts of an ECG recorder.
7. List the lead configurations used in ECG.
8. List the ranges of frequency and voltage related to EEG.
9. Recall the instrument that is used to find epilepsy.
10. Define tidal volume.

Understand

1. Summarize the characteristics of resting potential and action potential in the cell.
2. Explain the origin of different heart sounds.
3. Summarize the cardio pulmonary blood circulation system.
4. Abstract the principle and working of electromagnetic blood flow meters.
5. Explain the working of X-ray machine.
6. Illustrate the operation of ultrasonic imaging systems.

Apply

1. Implement the M mode for the ultrasonic imaging system with a suitable diagram.
2. Find the differences in the function of ventricular asynchronous pacemaker and ventricular synchronous pacemaker.
3. Demostrate how many electrodes are required to be attached to a human subject for recording any one of the unipolar chest lead signals? In the standard 12-lead ECG recording system.
4. Construct with a schematic sketch an EEG measuring system.
5. Find out the merits of medical thermography.
6. Implement a biotelemetry with suitable applications with a neat sketch.

7. Compute the function of ventricular asynchronous pacemaker and ventricular synchronous pacemaker.
8. Asses the working of the ultrasonic imaging system (M-mode) with a suitable diagram.
9. Execute the working of an 12 lead ECG machine with a neat block diagram.

Analyse

1. Compare between metallic microelectrode and non-metallic microelectrode.
2. Outline the different types of heart sounds for different condition with specific schematic wave forms.
3. Conclude on what parameters does the free running frequency of VCO depend on?
4. Outline the various electro surgery techniques used in diathermy unit.
5. Justify the essential use of a coupling medium like olive oil or special jelly are essential in ultrasonic imaging system?

Evaluate

1. Illustrate two types of audio aids with diagram
2. Choose type of electrode the hydrogen ion concentration of the blood is easily determined?

Create

1. Produce a biotelemetry system with necessary components with its schematic sketch.
2. Relate a CT imaging to a MRI scan. Justify the same with principles and diagrams

15EI707 INDUSTRIAL AUTOMATION LABORATORY 0 0 2 1

Course Objectives

- To obtain practical knowledge in advanced controllers
- To automate linear and non linear processes
- To design discrete controller for a transfer function model

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Develop Ladder Logic Program in PLC (Allen bradly, Delta, Mitsubishi, omran, hornor) for controlling Level, Flow, Temperatur and Pressure at desired set value
2. Develop Ladder Logic Program in PLC (Allen bradly) to automate bottle filling process for beverage industries
3. Develop Ladder Logic Program in PLC (omran) to provide solution for traffic issues.
4. Develop Functional Block diagram Program in Honeywell-DCS for controlling Level, Flow, Temperature and Pressure at desired set value by implementing cascade loop structure.
5. Interface and Configure DCS for Sequence control and Interlocking process for real time applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3		3				3					3
2	2	2	3		3				3					3
3	2	2	3		3				3					3
4	2	2	3		3				3					3
5	2	2	3		3				3					3

1 **3 Hours**

EXPERIMENT 1

Level and flow control using PLC

2 **3 Hours**

EXPERIMENT 2

Control of automatic bottle filling system using PLC.

3 **3 Hours**

EXPERIMENT 3

Traffic light control system using PLC (Sequence output instruction)

4 **3 Hours**

EXPERIMENT 4

Interfacing Variable Frequency Drive with PLC

5 **3 Hours**

EXPERIMENT 5

Implementation of PID controller for multi loop process

6 **3 Hours**

EXPERIMENT 6

Pressure and Flow control using DCS

7 **3 Hours**

EXPERIMENT 7

Design of interlock system using DCS

8 **3 Hours**

EXPERIMENT 8

Configuring DCS- System for sequence control

9 **3 Hours**

EXPERIMENT 9

Temperature control process using PLC

10 **3 Hours**

EXPERIMENT 10

Configuring DCS- System for cascade control

11 **0 Hours**

EXPERIMENT 11

Mini project for laboratory experiments

Total: 30 Hours

15EI708 DESIGN LABORATORY 0 0 2 1

Course Objectives

- To obtain adequate knowledge in design of various signal conditioning circuits, instrumentation systems, controller and control valve
- Infer and Perform control panel wiring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Implement the Variable frequency drive and HMI for real time process
2. Design of simple transmitter circuit using sensor/transducers and amplifiers
3. Calibrate final control elements or transmitter
4. Infer and Perform control panel wiring
5. Develop documentation of instrumentation projects and development of P&I for process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	2	2	1	2	1	1				1	2
2	2	3	1	2	2		2	2	1				1	2
3	3	2	2	3	2		1	2	2				2	2
4	2	3	2	3	2		2	2	2				1	3
5	3	3	2	2	3		2	3	2				2	3

1 **3 Hours**

EXPERIMENT 1
Development of Panal diagram for a heat exchanger process.

2 **6 Hours**

EXPERIMENT 2
Implementation of Variable Frequency Drive circuit for motor speed control.

3 **6 Hours**

EXPERIMENT 3
Design of P, PI and PID controllers using operational amplifier.

4 **3 Hours**

EXPERIMENT 4
Design an orifice plate for a typical application using simulation.

5 **3 Hours**

EXPERIMENT 5
Implementing signal condition circuit for strain gauge using virtual instrumentation.

6 **6 Hours**

EXPERIMENT 6

Design of instrumentation amplifier.

7 **6 Hours**

EXPERIMENT 7

Configuring Human Machine Interface for a given application.

8 **3 Hours**

EXPERIMENT 8

Control panel design.

9 **3 Hours**

EXPERIMENT 9

Design of temperature transducer.

10 **6 Hours**

EXPERIMENT 10

Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

Total: 45 Hours

15EI709 MINI PROJECT V 0 0 2 1

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	2	2	3	3	3	-	-	2		
2	3	3	3	2	3	2	3	3	3	-	2	-		
3	3	3	3	3	2	2	3	3	3	-	2	-		
4	3	3	3	3	3	2	2	3	-	-	-	-		
5	3	3	2	3	3	2	2	3	3	2	-	-		

Total: 0 Hours

15GE710 LIFE SKILLS : COMPETITIVE EXAMS 0 0 2 0

Course Objectives

- Understand the concepts of applied mechanics, Theory of Machines and Design.
- Understand the concepts of Fluid Mechanics and Thermal Engineering.
- Understand the concepts of Materials, Manufacturing and Industrial Engineering.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Solve the problems related to applied mechanics, Theory of Machines and Design concepts
2. Solve the problems related to Fluid Mechanics and Thermal Engineering
3. Explain the concepts of Materials, Manufacturing and Industrial Engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2										3		
2	1	2										3		
3	1	2										3		

1 **10 Hours**

UNIT 1

Engineering Mechanics-Statics and Dynamics, Mechanics of Materials- deflection of beams, testing of materials, Theory of Machines- Kinematics and Dynamics, Vibrations, Machine Design- design of machine elements, shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

2 **10 Hours**

UNIT 2

Fluid Mechanics, Thermodynamics, Heat-Transfer-conduction, convection and radiation, Power Engineering: Air and gas compressors, I.C. Engines, refrigeration, air-conditioning, Turbomachinery.

3 **10 Hours**

UNIT 3

Engineering Materials, Casting, Forming and Joining Processes, Machining and Machine Tool Operations, Metrology and Inspection, Computer Integrated Manufacturing, Production Planning and Control, Inventory Control, Operations Research.

Total: 30 Hours

Reference(s)

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India Learning Pvt. Ltd, New Delhi, 2010
2. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2003.
3. R.K. Bansal, A Textbook of Fluid Mechanics and Machinery, Laxmi Publications Ltd., New Delhi, Revised Ninth edition, 2014.
4. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2010.

5. Beer, Johnston, Mazurek, Cornwells and Sanghi, Vector Mechanics for Engineers: Statics, Dynamics, 10th Edition, Tata McGraw Hill - Noida, Uttar Pradesh, 2013
6. Behrouz A.Forouzan, Data Communication and Networking, 5th Edition, Tata McGraw-Hill, 2014.

15EI804 PROJECT WORK 0 0 0 9

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3	2			2	1						2	3
2	2	2	1	3		2					2	2	2	3
3			3	2	2			2			2	2	2	3
4		1		2	3	1	2	2					2	3
5									3	3		2	2	3

Total: 0 Hours

15LE101 BASIC ENGLISH I 3 0 0 3

Course Objectives

- To teach students basic English vocabulary and tenses
- To offer practice on various conversation patterns
- To improve spelling and pronunciation by offering rigorous practice and exercises

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Students will be able to: Form sentences using basic grammar and vocabulary in English
2. Involve in basic day-to-day conversation
3. Express opinions, agree & disagree on topics of general interest
4. Listen and understand Indian English audio clippings
5. Understand reading comprehension passages and answer related questions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2										3				
3										3				
4										2				
5										2				

UNIT I **7 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
1 Basic words- 12 most used words in English, usage and pronunciation Starting a conversation and talking about what one does Sentence construction bolstered by mother tongue
2 Basic words- 20 often used words, usage and pronunciation Analyzing an action plan Creating and presenting oneÃƒÂ¢??s own action plan
3 Basic words with a focus on spelling Discriminative listening Informal conversation
4 Basic words- 10 often used words, usage and pronunciation Content listening and Intonation Reading comprehension
5 Unit Test I

UNIT II **8 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
6 Basic words + greetings to be used at different times of the day Formal conversation Intonation to be used in formal address
7 Last 28 of the 100 most used words Informal conversation between equals Reading practice and peer learning
8 Using the 14 target words to form bigger words Informal dialogues using contracted forms Guided speaking- talking to peers using contracted forms
9 Palindromes, greetings- good luck, festivals Placing a word within its context- culling out meaning Offering congratulations
10 Unit Test II

UNIT III **7 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
11 Homophones Formal and informal methods of self-introduction Let's Talk is a group activity that gives them some important pointers of speech
12 Homophone partners, matching words with their meanings Contracted forms of the -be verbs, -ve and -s Translating English sentences to Tamil
13 Briefcase words- finding smaller words from a big word Formal and informal ways of introducing others Team work- speaking activity involving group work, soft skills
14 Compound words and pronunciation pointers Giving personal details about oneself using the lexicon
15 Unit Test III

UNIT IV **8 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
16 Proper and common nouns Asking for personal information and details Pronunciation pointers- an informal introduction to the IPA
17 Pronouns Telephone skills and etiquette Reading aloud and comprehension
18 Abstract and common nouns Dealing with a wrong number Reading practice and comprehension
19 Group names of animals, adjectives Taking and leaving messages on the telephone Pronunciation pointers
20 Unit Test IV

UNIT V **8 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
21 Determiners Interrupting a conversation politely- formal and informal Pair work reading comprehension

22 Conjugation of the verb to be- positive and negative forms Thanking and responding to thanks Comprehension questions that test scanning, skimming and deep reading
23 Am/is/are questions Giving instructions and seeking clarifications Small group activity that develops dialogue writing
24 Present continuous tense-form and usage Making inquiries on the telephone Finishing sentences with appropriate verbs
25 Unit Test V

UNIT VI **7 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
26 Words with silent 'b' Present continuous questions Calling for help in an emergency Dialogue writing
27 Words with silent 'c' Simple present tense- form and usage Making requests and responding to them politely Identifying elements of grammar in text extract
28 Simple present tense- rules Describing people Guided writing
29 Words with silent 'g' Questions in the simple present tense Describing places Filling in the blanks with correct markers of tense
30 Unit Test VI

Total: 45 Hours

Reference(s)

1. 1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE102 COMMUNICATIVE ENGLISH I 3 0 0 3

Course Objectives

- To communicate effectively in social scenario
- To enhance the ability of reading, summarising and paraphrasing information
- To develop the techniques of writing through appropriate use of grammar and vocabulary

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and comprehend different spoken discourses
2. Communicate ideas in English fluently during personal / official conversations
3. Use grammar and vocabulary required at CEFR B1 level in spoken and written discourses
4. Read and understand general & technical text
5. Involve in formal written communication using appropriate mechanics of writing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										3				
3										1				
4										2				
5										3				

UNIT I **9 Hours**

GRAMMAR

Content words- Structural words - Subject - Verbs and verb phrase - Subject - Verb agreement - Tenses - Active voice and passive voice - Sentence types (declarative, imperative, exclamatory & interrogative) - Framing questions - Comparative adjective

UNIT II **9 Hours**

LISTENING

Listening for specific information: Short conversations / monologues - Impersonal passive - Gap filling - Telephone conversations - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Telephone etiquette

UNIT III **9 Hours**

READING

Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure - Note Making

UNIT IV **9 Hours**

WRITING

Letter Writing: Formal letters / Job application - E-mail writing Ã¢?? Report & Proposal writing - Advertisement - Principles of writing a good paragraph: Unity, cohesion and coherence - Paragraph writing (descriptive, narrative, expository & persuasive)

UNIT V **7 Hours**

SPEAKING

Self-introduction (Elevator Pitch) - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Likes and dislikes - Tongue twisters

FOR FURTHER READING

Short stories: "The Astrologer's Day" by R. K Narayan “How Much Land does a Man Need?" by Leo Tolstoy

Total: 43 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use - A Self-Study Reference and Practice Book For Intermediate Learners Of English .IVed. United Kingdom: Cambridge University Press. 2012.
2. 2.Seely, John. Oxford Guide to Effective Writing and Speaking. Indian edition. New Delhi: Oxford University Press. 2005.
3. 3. Anderson, Kenneth. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press. 2004.

15LE201 BASIC ENGLISH II 3 0 0 3

Course Objectives

- To focus on natural acquisition of rudimentary structures in English language through ample listening, reading and writing inputs
- To concentrate on speaking and conversation skills with a view to increase fluency in speaking
- To enhance the ability of correct pronunciation and spelling

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. The students will be able to: Express themselves clearly in English to individuals / groups without hesitation
2. Comprehend simple day-to-day formal/ informal conversations
3. Use various forms of tenses in speaking and writing
4. Read and understand paragraphs on simple topics
5. Write coherent paragraphs / reports / letters on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										2				
3										1				
4										2				
5										3				

UNIT I **8 Hours**

Module Vocabulary/ Grammar Skills Sets Skill Sets
31 Difference between Present Continuous and Simple Present tense. Calling for help in an emergency Reporting an event- journalistic style
32 Verbs 'have' and 'have got' Describing animals Asking for and giving directions
33 Simple Past Tense Inviting people, accepting and declining invitations Self-enquiry and offering one's opinion on a given topic.
34 Spelling rules & table of Irregular Verbs Refusing an invitation Reading and practicing pre-written dialogues
35 Unit Test I

UNIT II **7 Hours**

36 Questions and the negative form of the simple past tense Apologizing and responding to an apology (Reading) conversation practice
37 Asking questions in the simple past tense Reading comprehension Seeking, granting and refusing permission

38 Past continuous tense Paying compliments and responding to them Pair work: writing dialogues and presenting them
39 Difference between simple past and past continuous- when and where to use each Describing daily routines Reading and comprehension skills
40 Unit Test II

UNIT III **7 Hours**

41 Simple future tense Talking about the weather Making plans- applying grammar theory to written work
42 Simple future tense- more aspects, possessive pronouns Talking about possessions Opening up and expressing one's emotions
43 Future continuous tense Talking about current activities Listening comprehension
44 Revision of future tense- simple and continuous forms, prepositions used with time and date Asking for the time and date Discussion- analyzing and debating a given topic
45 Unit Test III

UNIT IV **8 Hours**

46 Articles a/an Writing, speaking and presentation skills Transcribing dictation
47 Singular- Plural (usage of a/an) Reading practice- independent and shared reading Comprehension - logical analysis, process analysis and subjective expression

48 Countable and uncountable nouns- a/an and some Listening comprehension Vocabulary: using context tools to decipher meaning
49 Articles- the Sequencing sentences in a paragraph Listening to a poem being recited, answer questions on it and practice reciting the same
50 Unit Test IV

UNIT V **7 Hours**

51 Articles- the: usage and avoidance Speaking: sharing stories about family, village/town, childhood, etc. 10 students Listening: comprehend and follow multiple step instructions read out by the teacher
52 Articles- the: usage and avoidance with like and hate Speaking: sharing stories about family, village/town, childhood, etc. 10 students Reading: make inferences from the story about the plot, setting and characters
53 Articles- the: usage and avoidance with names of places Speaking: sharing stories about family, village/town, childhood, etc. 10 students Comprehension passage
54 This/ that/ these and those Writing a notice- announcement Speaking: Debate
55 Unit Test V

UNIT VI **8 Hours**

56 One and ones Collaborative learning- problem solving Writing short answers to questions based on reading
57 Capitalization and punctuation Controlled writing Listen to a story and respond to its main elements
58 Syntax and sentence construction- rearrange jumbled sentences Guided writing Listen to a poem and discuss its elements
59 Cloze Free writing Frame simple yet purposeful questions about a given passage
60 Unit Test VI

Total: 45 Hours

Reference(s)

1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE202 COMMUNICATIVE ENGLISH II 3 0 0 3

Course Objectives

- To acquire skills for using English language effectively in workplace
- To prepare students for taking BEC Vantage level examination
- To enhance the communicative ability from Intermediate to Upper Intermediate level
- To enhance the communicative ability from Intermediate to Upper Intermediate level

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. The students will be able to: Express themselves orally while interacting with individuals or groups in formal occasions
2. Listen and comprehend business conversations
3. Read and understand business correspondences and company literature
4. The students will be able to use language structures and vocabulary that is required at CEFR B2 level
5. Communicate effectively through formal and informal written business correspondences

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										2				
3										2				
4										1				
5										3				

UNIT I **9 Hours**

GRAMMAR AND VOCABULARY

Simple, Compound and Complex sentences - Direct and Indirect speech - Conditionals -Business vocabulary - Collocations - Discourse markers

UNIT II **9 Hours**

LISTENING

Listening to specific information - short notes - Listening to identify topic, content, function - Sentence stress - Rhythm - Intonation

UNIT III **9 Hours**

READING

Reading graphs and charts - Skimming and scanning texts - Gap Filling - Read business articles for specific information - Understanding the structure of a text - Error identification

UNIT IV **9 Hours**

WRITING

Formal and Informal English - Business Correspondence, Short Documents: e-mail, memo, message, - Longer Documents: Reports and Proposals - Transcoding

UNIT V **9 Hours**

SPEAKING

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging information - Language Functions: suggesting - comparing and contrasting -expressing - Finding out facts, attitudes and opinions - Commonly mispronounced words

FOR FURTHER READING

Newspaper and Magazine reading (The Hindu / The New Indian Express / Times of India, India Today / ReadersÃ¢?? Digest) - Reading Novels (The Monk Who Sold His Ferrari by Robin Sharma; Three Mistakes by Chetan Bhagat; The Fountain head by Ayn Rand)

Total: 45 Hours

Reference(s)

1. 1.Guy Book- Hart, BEC Vantage Cambridge Business Benchmark, Upper-Intermediate Cambridge University Press, 2006.
2. 2.Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course in Reading for Academic Purposes. United Kingdom: Cambridge University Press, 2004.

15LC203 CHINESE 3 0 0 3

Course Objectives

- To help students acquire the basics of Chinese language
- To teach the student show to converse in Chinese in various situations
- To teach Chinese cultural facets and social etiquettes to the students

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Identify Initials and Finals of Chinese Alphabet.
2. Recognise four different tones in a spoken Chinese sentence.
3. Read Mandarin Chinese through Pinyin.
4. Form sentences using basic Chinese vocabulary.
5. Listen and understand basic Chinese conversation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2										2				
3										2				
4										3				
5										2				

UNIT I **9 hours**

Nǐhǎo-你好

Xuéhuìwènhòu de jīběnbiǎodáyòngyǔ - 学会问候的基本表达用语 ; Xuéhuìjièshàozìjǐ de xìngmíng, guójí - 学会介绍自己的姓名，国际 ; Xuéhuìhànyǔpīnyīn de shèngmǔ - 学会汉语拼音的圣母 ; yùnmǔhéshēngdiào - 韵母和声调 ; Pīndúhéshēngdiàoliànxí - 拼读和声调练习

UNIT II **9 hours**

Xiànzàijǐdiǎn-现在几点

Xuéhuìshíjiān, rìqí de biǎodá - 学会时间，日期的表达 ; Rèshēn - 热身 ; Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ;Huódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ; Xuécíyǔshuōshíjiān ; Tìhuànliànxí - 替换练习Dúyīdúránhòuliánxiàn - 读一读然后连线 ; Bǎxiàmiàn de cíànzhèngquè de shùnxùpáilièchéngjù - 把下面的词按正确的顺序排列成句

UNIT III **9 hours**

Nàjiànmáoyīzěnmemài? -那件毛衣怎么**卖?**

Xúnwènjiàqiánjíqián de biǎodá - 询问价钱及钱的表达 ; Tǎojiàhuánjià - 讨价还价 ; Tíchūduìsuǒmǎidōngxīdàxiǎo,yánsèděngděngjùtǐyāoqiú - 出对所买东西大小，颜色等等具体要求 ; ShēngcíHuódòng - 活动 ;Kàntúwánchénghuìhuà - 看图完成会话 ; Xuécíyǔshuōshíjiān ;Dúyīdúránhòuliánxiàn - 读一读然后连线 ;Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表

UNIT IV **9 hours**

Xuéhuìxúnwènjiātíngqíngkuàng, zhíyèhéniánlíng - 学会**询问家庭情况，职业和年龄**

Xuéhuìdiǎncàitíyāoqiújiézhàng - 学会点菜提要求结账 ; Shēngcí - 生词 ; Jùzi - 句子 ;Huìhuà - 会话 ;Huódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ; Xuécíyǔshuōshíjiān ;Dúyīdúránhòuliánxiàn - 读一读然后连线 ;Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表Juésèbànyǎn - 角色扮演 ; Tīnglùyīnpànduànduìcuò - 听录音判断对错

UNIT V **9 hours**

Nĭzàinǎ'ergōngzuò -在哪儿工作

Xuéhuìxúnwènjiātíngqíngkuàng, zhíyèhéniánlíng- 学会询问家庭情况，职业和年龄Shēngcí- 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ; Huódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ;Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表 - Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案; Bǔchōngcíyǔbiǎo - 补充词语表

Total: 45 hours

Reference(s)

1. David J. White. My Chinese Classroom, 2005
2. Tiyan Hanyu Shenghuo Pian, Experiencing Chinese, Ying Yu Ban Di 1 Ban. Beijing: Higher Education Press: Gaodengjiaohuchu ban she. 2011
3. Hancel, Don. Mandarine Day. Chinese learning Software
4. www.chinesexp.com.cn www.yiwen.com.

15LF203 FRENCH 3 0 0 3

Course Objectives

- To help students acquire familiarity in the French alphabet & basic vocabulary
- To teach the students to use French in simple day-to-day conversations
- To prepare the students for French examination (level A1)

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and comprehend individual sounds of French and simple day-to-day conversations.
2. Apply basic sounds and words in simple sentences for communication
3. Read and understand short passages on familiar topics.
4. Frame basic sentence structures while writing.
5. Recognize and apply basic grammar and appropriate vocabulary in completing language tasks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										3				
3										2				
4										3				
5										1				

Unit I **6 Hours**

Alphabet Français et Les Accents Français - Les articles définis, indéfinis Genre - Singulier et pluriel – Salutations

Unit II **8 Hours**

Verbes - Conjugaison : Présent (Avoir / Être / ER, IR, RE : Régulier et Irrégulier) - Adjectifs - Nationalités - Professions - Formuler les questions **LIRE**

Unit III **8 Hours**

Les jours de la semaine - Les mois de l'année - Les saisons - Numéros - Quelle heure est - il ? - Famille - Articles Contractés - Préposition - Adjectifs Possessifs **PARLER :** Se présenter **; LIRE**

UNIT IV **9 Hours**

Verbes - Conjugaison : Impératif, Futur proche, Passé-récent (ER / IR / RE : Régulier et Irrégulier) - Articles Partitifs - Adjectifs Démonstratifs - La Gastronomie Française. **PARLER ; LIRE**

UNIT V **14 Hours**

Verbe Conjugaison : Passé-composé, Imparfait, Futur simple, Conditionnel (ER / IR / RE : Régulier et Irrégulier) - Carte Postale - Courriel **PARLER :** Jeu de Rôle**; ÉCOUTER** Compréhension Orale

Total : 45 Hours

References :

1. Grammaire Progressive du Français, CLÉ International, 2010.
2. Collins Easy Learning French Verbs & Practice, Harper Collins, 2012.
3. Barron's Learn French, 3rd Edition, Elizabeth Bourquin, Language Institute, 2012.
4. Cours de Langue et de Civilisation Françaises, G. Mauger, Hachette, 2014.
5. Saison 1, Marie-Noëlle Cocton et al, Didier, 2014.

Softwares :

1. Français Linguaphone : Linguaphone Institute Ltd., London, 2000.
2. Français Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001.

15LG203 GERMAN **3 0 0 3**

Course Objectives

- To help students acquire the basics of German language
- To teach them how to converse in German in day-to-day situations ÃƒÂ¢?Ã‚Â¢ To teach them how to converse in German in day-to-day situations

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of German and simple day-to-day conversations.
2. Speak simple sentences using basic sounds and words.

3. Read and understand short passages on familiar topics.
4. Apply basic sentence structures while writing.
5. Apply basic grammar and appropriate vocabulary in completing language tasks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										3				
3										2				
4										3				
5										1				

UNIT I **6 Hours**

Introduction to German language: Alphabets - Numbers - Greetings - country - nationalities - Working with Dictionary.

UNIT II **6 Hours**

Nouns - Pronouns - definite and indefinite article - Speaking about oneself - Listening to CD supplied with the books, paying special attention to pronunciation.

UNIT III **11 Hours**

Regular verbs - Conjugation - Irregular verbs - Time - Negation - adjectives - family - profession - Introduction to types of sentences

UNIT IV **12 Hours**

Question words - Types of Questions - Nominative - Accusative and dative case - framing basic questions and answers - Writing short notes and letter- reading the news boards, directions

UNIT V **10 Hours**

Imperative case - Possessive articles - propositions - modal auxiliaries - Basic dialogue and group conversation - ordering in restaurants.

Total: 45 Hours

Reference(s)

1. Continuum International Publishing Group Ltd. London / New York, 1992. Eckhard, Christine. Whittle, Black & Ruth. Cassel Language Guides - German.
2. Rusch, Paul. Netzwerk A1. Deutsch AlsFremdsprache. Goyal Publishers & Distributers Pvt. Ltd. New Delhi, 2015.
3. Langenscheidt Universal German Dictionary: German-English, English-German. Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
4. Grundkurs Deutsch A Short Modern German Grammar Workbook and Glossary. Verlag Fur Deutsch.Munichen, 2007.
5. Grundkurs. Deutsch Lehrbuch. Hueber. Munichen, 2007.

15LH203 HINDI 3 0 0 3

Course Objectives

- To help students acquire the basics of Hindi language
- To teach them how to converse in Hindi in day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Read and identify Hindi letters, words and simple sentences.
2. Construct simple sentences and use appropriate vocabulary during day-to-day oral communication.
3. Identify basic sounds of Hindi language and understand simple conversations on familiar topics.
4. Write common words and sentences.
5. Comprehend elementary level grammar of Hindi.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										3				
3										2				
4										3				
5										1				

UNIT I **9 Hours**

HINDI ALPHABET

Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu&Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS IN HINDI

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

PRONOUNS AND TENSES

Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Parts of body - Relatives - Spices- Eatables- Fruit & Vegetables - Clothes - Directions-Seasons - Professions.

UNIT V **9 Hours**

SPEAKING

Model Sentences - Speaking practice for various occasions.

Total: 45 Hours

Text Book(s)

1. B. R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.

Reference(s)

1. Syed, PrayojanMulak Hindi, RahamathullahVaniPrakasan, New Delhi, 2002.
2. Ramdev, VyakaranPradeep, SaraswathiPrakasan, Varanasi, 2004.

15LJ203 JAPANESE 3 0 0 3

Course Objectives

- To help students learn Japanese alphabet
- To teach students how to use the basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Recognise and write Japanese alphabet.
2. Speak using basic sounds of the Japanese language.
3. Apply appropriate vocabulary needed for simple conversation in Japanese language.
4. Apply appropriate grammar to write and speak in Japanese language.
5. Comprehend the conversation and give correct meaning.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										1				
3										3				
4										1				
5										2				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script - Pronunciation of Japanese(Hiragana) - Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 des - N1 wa N2 ja arimasen - S ka - N1mo - N1 no N2 - .san - Kanji - Technical Japanese Vocabulary (25 Numbers) - Phonetic and semantic resemblances between Tamil and Japanese

UNIT II **9 Hours**

Introduction - Kore - Sore - are - Kono N1 - Sono N1 - ano N1 - so des - so ja arimasen - S1 ka - S2 ka - N1 no N1 - so des ka ' koko - soko - asoko - kochira - sochira - achira - N1 wa N2 (Place) des - dhoko-N1 no N2 - Kanji-10 - ima-.ji-fun des - Introduction of verb - V mas - V masen - V mashitha - V masen deshitha - N1(Time) ne V - N1 kara N2 des - N1 tho N2 / S ne Kanji-10 - Technical Japanese Vocabulary (25 Numbers) - Dictionary Usage.

UNIT III **9 Hours**

- N1(Place) ye ikimas - ki mas - kayerimasu - Dhoko ye mo ikimasen - ikimasendheshitha - N1(vehicle) de ikimasu - kimasu - kayerimasu - N1(Personal or Animal) tho V ithsu - S yo. - N1 wo V (Transitive) - N1 wo shimus - Nani wo shimasu ka - Nan & Nani - N1(Place) de V - V masen ka - V masho - Oo. Kanji-10 , N1(tool - means) de V - Word / Sentence wa go nan des ka - N1(Person) ne agemus - N1(Person) ne moraimus - mo V shimashitha - , Kanji-10 - Japanese Typewriting using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

UNIT IV **9 Hours**

Introduction to Adjectives - N1wanaadj des. N1 wa ii adj des - naadjna N1 - ii adj ii N1 - Thothemo - amari - N1 wadho des ka - N1 wadhonna N2 des ka - S1 ka S2 - dhore - N1 gaarimasu - wakarimasu - N1 ga suki masu - N1 gakiraimasu - jozu des - hetha des - dhonna N1 - Usages of yoku - dhaithai - thakusan - sukoshi - amari - zenzen - S1 kara S2 - dhoshithe, N1 gaarimasu - imasu - N1(Place) ne N2 gaarimasu - iimasu - N1 wa N2(Place) ne arimasu - iimasu - N1(Person,Place,or Thing) no N2 (Position) - N1 ya N2, Kanji-10 - Japanese Dictionary usage using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

UNIT V **9 Hours**

Saying Numbers , Counter Suffixes , Usages of Quantifiers -Interrogatives - Dhonokurai - gurai - Quantifier-(Period) ne -.kai V - Quantifier dhake / N1 dhake Kanji - Past tense of Noun sentences and na Adjective sentences - Past tense of ii-adj sentences - N1 wa N2 yoriadj des - N1 tho N2 tho Dhochiragaadj des ka and its answering method - N1 [no naka] de {nani/dhoko/dhare/ithsu} ga ichiban adj des ka - answering -N1 gahoshi des - V1 mas form dhake mas - N1 (Place) ye V masu form ne ikimasu/kimasu/kayerimasu - N1 ne V/N1 wo V - Dhokoka - Nanika - gojumo - Technical Japanese Vocabulary (25 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Software 1. Nihongo Shogo-1 2. Nihongo Shogo-2 3. JWPCE Software 3. JWPCE Software
2. 1. www.japaneselifestyle.com 2. www.learn-japanese.info/ 3. www.kanjisite.com/ 4. www.learn-hiragana-katakana.com/typing-hiragana-characters/

15PH201 PHYSICS OF MATERIALS 3 0 2 4

Course Objectives

- To understand the physical properties of conductors, semiconductors and superconductors
- To recognize the basic principles of interaction of light with matter and working of optical devices
- To classify the types of dielectric, magnetic materials and polarization mechanisms with their properties

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the properties of conductors and superconductors for different applications
2. Apply the concepts and types of semiconductors for solar cell applications
3. Discuss the types, properties and applications of dielectric materials
4. Explain the properties of optical materials, working mechanism of LEDs and LCDs
5. Classify the magnetic materials with their properties and apply in the data storage devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2	1							2					
3	2	1												
4	2	1												
5	2	1							2					

UNIT I **9 Hours**

CONDUCTING AND SUPERCONDUCTING MATERIALS

Electrical and thermal conductivity of metals - Wiedemann Franz law - band theory of metals - density of states. Superconductors: properties - types - High Tc superconductors- applications.

UNIT II **10 Hours**

SEMICONDUCTORS

Elemental and compound semiconductors - intrinsic semiconductors: carrier concentration - electrical conductivity- band gap. Extrinsic semiconductors: carrier concentration - variation of Fermi level. Hall effect: theory and experimental determination -applications:Solar cells

UNIT III **9 Hours**

DIELECTRIC MATERIALS

Types of polarization: electronic, ionic, orientation and space charge polarization mechanisms - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric strength and loss -dielectric breakdown mechanisms - active dielectric materials: pizo, pyro and ferroelectricity - applications.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Interaction of light with materials - optical absorption - transmission - Luminescence in solids - Fluorescence and Phosphorescence - Optical band gap - LED ,LCD.

UNIT V **8 Hours**

MAGNETIC MATERIALS

Classification and properties - domain theory - hard and soft magnetic materials - anti-ferro and ferri magnetic materials - applications: magnetic recording and memories.

FOR FURTHER READING

Photonic crystals - LIFI

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of travelling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13th revised edition, Meerut, India, 2013.
2. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
3. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
4. M.A. Wahab, N.K. Mehta, Solid state physics-structure and properties of materials, Narosa publishing house Pvt. Ltd, 6th edition, 2010.
5. Semiconductor Physics and Devices, Donald A. Neamen , Mc Graw-Hill, 2011.
6. P.K. Palanisamy, Materials Science, Scitech Publications India Pvt. Ltd, 2014.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	4	2		1	4	2		1	2			1	1											20
2	2		2		2		4		5	3			4												22
3	1	2	1		3	4			3	4			2												20
4	2	2			2	5			2	5			2												20
5	1	3			3	2	3		3	1			2												18
																								Total	100

Assessment Questions

Remember

1. State Meissner effect.
2. List six properties of superconducting materials.
3. Define photovoltaic effect.
4. List the six common applications of dielectric materials.
5. Retrieve optical absorption in metals.
6. Reproduce the principle of LCD in display devices.
7. Recall the term hysteresis in ferromagnetic materials.
8. List four applications of magnetic materials.
9. Recognize the need of optical band gap in differentiating the materials.
10. Reproduce five applications of hard magnetic materials in day to day life.

Understand

1. Explain the principle, construction and working of LED.
2. Classify the three types of materials based on band gap energy.
3. Interpret the working mechanism and characteristics of a solar cell.
4. Illustrate Hall effect experiment used to find the concentration of charge carriers in n- type semiconductors and hence explain the necessary theory.
5. Summarize the various dielectric breakdown mechanisms observed in dielectric materials.
6. Infer the principle involved in working of magnetic levitation.
7. Classify the two types of luminescence in solids with appropriate energy level diagrams.

8. Subsume the four types of polarization mechanisms involved in dielectric materials.
9. Illustrate the V-I characteristics of a solar cell.
10. Extrapolate the Clausius Mosotti equation for the dielectric material which is subjected to external electric field.

Apply

1. Free electron density of aluminum is 18.10x1028 m-3. Calculate its Fermi energy at 0K. Planck's constant and mass of free electron are 6.62x10-34 Js and 9.1x10-31 Kg.
2. Compute the relation between Remanence and Coercivity.
3. Demonstrate the domain theory of ferromagnetism.
4. Derive the expressions for electrical and thermal conductivity of metals and hence compute the Wiedemann Frantz law.
5. Compute the carrier concentration in intrinsic and extrinsic semiconductors.
6. Calculate the number of free electrons per unit volume in a metal in terms of Fermi energy.
7. Assess the Magnetic levitation and SQUIDS in day to day life.
8. Show the importance of dielectric breakdown mechanisms in dielectrics.
9. Implement the applications of dielectric materials in real world problems.
10. Compute the relation between polarization vector and electric field (E).

Analyse

1. Differentiate Phosphorescence and Fluorescence.
2. Can we increase the orientation polarization with increase in temperature? Justify
3. Justify the principle, construction, working, advantages and disadvantages of LCD.
4. Compare hard and soft magnetic materials.
5. Differentiate the ferromagnetic and anti-ferromagnetic materials with examples.
6. Compare dia, para and ferromagnetic materials.
7. Distinguish between polarization and polarizability.
8. Differentiate elemental and compound semiconductors.
9. Compare type I and type II superconductors.
10. Compare LED and LCD.

15PH202 APPLIED PHYSICS 3 0 2 4

Course Objectives

- To understand conducting, semiconducting, dielectric and magnetic properties of materials and exemplify their applications
- To analyze the basic concepts of thermodynamics and heat transfer with illustrations
- To gain knowledge about acoustical standards of buildings

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the physical properties of conducting and semiconducting materials
2. Discuss the physical properties of dielectric and magnetic materials with their applications
3. Apply the thermodynamic processes and laws to compute the efficiency of heat engines
4. Compare the different heat transfer modes with real time applications of conduction
5. Explain the characteristics of music and select proper sound absorbing materials for good acoustic of buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2	1							2					
3	2	1												
4	2	1												
5	2	1							1					

UNIT I **11 Hours**

CONDUCTORS AND SEMICONDUCTORS

Conductors: Classical free electron theory - electrical and thermal conductivity- Wiedemann - Franz law - merits and demerits of classical free electron theory - band theory - density of states. Semiconductors: Elemental and compound semiconductors - intrinsic semiconductors -Fermi level and electrical conductivity - band gap energy - extrinsic semiconductors - n-type and p-type semiconductors: variation of Fermi level with temperature (qualitative) - Hall effect - applications.

UNIT II **9 Hours**

DIELECTRIC AND MAGNETIC MATERIALS

Dielectrics: Fundamental terminologies - electronic and ionic polarizations - orientation polarization mechanism (qualitative) - space charge polarization - Langevin -Debye equation - dielectric loss - applications of dielectric and insulating materials. Magnetic Materials: Properties of dia, para and ferromagnetic materials - domain theory of ferromagnetism - hysteresis curve - hard and soft magnetic materials - applications

UNIT III **9 Hours**

THERMODYNAMICS

Zeroth law of thermodynamics - Heat - equilibrium and quasistatic process - path functions -comparison between heat and work - internal energy - first law of thermodynamics - isothermal and adiabatic process - work done - reversible and irreversible process - second law of thermodynamics - entropy - enthalpy - Carnot ideal engine and its efficiency - Carnot's theorem-actual heat engine: Diesel engine and its efficiency

UNIT IV **9 Hours**

HEAT TRANSFER

Modes of heat transfer - thermal conductivity - heat capacity and diffusivity - rectilinear flow of heat - conduction through bodies in series and parallel - determination of thermal conductivity: good conductor:

Searle's method - bad conductor: Lee's disc method - applications of heat transfer: formation of ice in ponds - conductivity of earth's crust and age of earth - practical applications

UNIT V **7 Hours**

ACOUSTICS

Classification of sound based on frequency - characteristics of audible sound - reverberation time: Sabine's formula - determination of absorption coefficient - Erying's formula (qualitative). Sound insulation - sound absorbing materials - factors affecting the acoustics of building - remedies

FOR FURTHER READING

Nanomaterials and its applications

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons,Inc, 2010
2. BrijLal, N. Subrahmanyam and P. S. Hemne, Heat, Thermodynamics & Statistical Physics, S. Chand & Company Ltd., New Delhi, 2012
3. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13threvised edition, Meerut, India, 2013
4. P.K. Mittal, Applied Physics, I.K. International Publishing House Pvt. Ltd, 2008
5. Donald A. Neamen, Semiconductor Physics and Devices,McGraw-Hill, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	3	4				3				4	4			2					4						24
2	2	2				4	2			2	4			4											20
3	2	4				4	2			4	2			2											20
4	2	2				4	2			2	4			4											20
5	2	2				2	2			4					4										16
																								Total	100

Assessment Questions

Remember

1. State Ohm’s law.
2. Define drift velocity.
3. List the two drawbacks of classical free electron theory.
4. State Wiedemann-Franz law.
5. Mention the practical unit used for electron’s magnetic moment.
6. Recall the term hysteresis in ferromagnetic materials.
7. List the four uses of magnetic materials.
8. State Zeroth law of thermodynamics.
9. State the Kelvin’s statement of second law of thermodynamics.
10. Name the three modes of heat transfer.
11. State Echelon effect.

Understand

1. Illustrate the significance of Fermi energy.
2. Why indirect gap semiconductors are preferred in fabricating transistors?
3. Classify the types of magnetic materials.
4. Outline the term retentivity and coercivity.
5. Compare dia, para and ferro magnetic materials.
6. Point out the ideal conditions required for diesel cycle.
7. Sketch the isothermal and adiabatic processes in P-V diagram.
8. Is it possible for a practical engine to have 100% efficiency? Justify.
9. Ice kept in saw dust or wrapper in a blanket will not melt. Why?
10. Classify the types of sound waves.
11. Explain the three characteristics of musical sound.

Apply

1. The average energy of a conduction electron in copper at 300 K is 4.23 eV. Calculate the Fermi energy of copper at 300 K.
2. Determine the carrier concentration of *p*-type semiconductor whose hall coefficient is 3.6610-4 m3/C.
3. Compute the efficiency of Carnot's engine operating between the temperatures 3270C and 270C.
4. Point out practical applications of heat conduction.
5. Compute the efficiency of Carnot's engine working the steam point and the ice point.
6. Assess the reason for the formation ice on pond surface.
7. The intensity of sound produced by thunder is 0.1 Wm-2.Calculate the intensity level in decibels.
8. Calculate Sabine's mathematical relation for reverberation time of the hall.
9. Compute the minimum wavelength of audible sound at zero degree centigrade.

Analyse

1. Distinguish between relaxation time and collision time.
2. Differentiate between electrical and thermal conductivity.
3. List the various applications of soft and hard magnetic materials for day to day life.
4. Analysis the six properties of hard and soft magnetic materials.
5. If the system and surrounding are in thermal equilibrium, is it necessary they are in same state? Comment the statement.
6. Differentiate isothermal and adiabatic process.
7. Entropy remains constant in an adiabatic process. Justify the statement.
8. Compare Carnot's cycle and diesel cycle.
9. Distinguish between loudness and intensity of sound.
10. Compare reverberation and echo.
11. How do you maintain optimum reverberation in a hall? Justify.

15PH203 MATERIALS SCIENCE 3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To impart fundamental knowledge in optical materials
- To understand the nature and applications of different magnetic materials

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

1. distinguish electrical properties of different kinds of conducting materials
2. identify the different types of semiconductors and its applications
3. categorize the various polarization mechanisms in dielectrics
4. choose the suitable material for the construction of display devices
5. select appropriate magnetic materials for magnetic storage devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2													
3	1													
4	1													
5	1													

UNIT I **8 Hours**

ELECTRICAL PROPERTIES OF METALS

Quantum free electron theory: Fermi-Dirac distribution function - Fermi energy and its variation with temperature - density of energy states - calculation of density of electrons and fermi energy at 0K - mean energy of electrons at 0K - problems.

UNIT II **10 Hours**

SEMICONDUCTING MATERIALS

Introduction - elemental and compound semiconductors - intrinsic semiconductors: expressions for number of electrons and holes - determination of carrier concentration and position of Fermi energy - electrical conductivity - band gap energy determination - carrier concentration in extrinsic semiconductors. Hall effect: theory and experimental determination - uses - problems.

UNIT III **9 Hours**

DIELECTRICS

Introduction - fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin - Debye equation - frequency and temperature effects on polarization - internal field - expression for internal field (cubic structure) - Clausius-Mosotti equation and its importance - applications of dielectric materials - problems.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Introduction - optical absorption in metals, semiconductors and insulators. Fluorescence and phosphorescence. Light emitting diode: principle, construction, working and applications. Liquid crystal display: general properties - dynamic scattering display - twisted nematic display - applications - comparison between LED and LCD. Blue ray disc - principle - working.

UNIT V **9 Hours**

MAGNETIC MATERIALS

Introduction - orbital and spin magnetic moments - Bohr magneton - basic definitions - classification of magnetic materials - domain theory of ferromagnetism - process of domain magnetization - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials.

FOR FURTHER READING

Optical data storage and Giant magnetoresistance

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons, Inc, 2010.
2. S.O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2014.
3. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
4. P.K. Palanisamy, Physics For Engineers, Scitech Publications (India) Pvt. Ltd., Chennai, 2010.
5. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, New Delhi, 2010.
6. R.K.Gaur and S.L.Gupta, Engineering Physics, Dhanpat Rai publications, New Delhi, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	5	2		1	5	2		1																18
2	2		2		2	3	2		5		2		4												22
3	1	2	1		3	3			3	5			2												20
4	2	3			3	3			2	5			2												20
5	1	3			3	2	5		3	1			2												20
																								Total	100

Assessment Questions

Remember

1. Define density of electron energy states in metals.
2. Recall Fermi energy.
3. State Hall Effect.
4. List out the four advantages of semiconductors.
5. Define dielectric constant
6. Recall electric polarization.
7. Define Fluorescence.
8. Recognize hard and soft magnetic materials.
9. State the working principle of LED.
10. Define Bohr magnetron.

Understand

1. Classify three types of free electron theory
2. Represent the variation of Fermi level with temperature
3. Explain Clausius-Mosotti relation.
4. Compare element and compound type semiconductors.
5. Illustrate the variation of Fermi level with temperature in n-type semiconductors.
6. Distinguish between a dielectric and insulator.
7. Mention the technique to increase the emission time in phosphorescence.
8. Exemplify hysteresis on the basis of domain theory of ferromagnetism.
9. Identify four examples for hard magnetic materials.
10. Identify four properties of ferromagnetic materials.

Apply

1. Compute the Fermi direc function for energy kT above the Fermi energy.
2. Asses the Fermi-Dirac distribution function.
3. Energy level of p-type and n-type semiconductors and justify the results
4. Compute the carrier concentration of intrinsic semiconductors
5. Explain the principle, construction and working of Hall Effect
6. Show that electronic and ionic polarizabilities are independent of temperature.
7. Calculate the polarization of an atom above value five.
8. Differentiate the dia, para and ferromagnetic materials.
9. Compute the B-H Hysteresis curve on the basis of domain theory.

Analyse

1. Discriminate drift velocity and thermal velocity of an electron
2. Difference between p-type and n-type semiconductors.

3. Obtain the expression for concentration of charge carriers in p-type semiconductor.
4. In practical dielectrics, the current does not exactly lead the voltage by 90?. Justify.
5. Local field is the space and time average of the electric field acting on a particular molecule Justify the result.
6. Justify the special features of magnetic blue ray disks.
7. Analyze the role of energies in the domain growth.
8. Explain the roll of activators in optical materials
9. Describe the working of twisted pneumatic display device.
10. Compare LED and LCD.

15PH204 PHYSICS OF ENGINEERING MATERIALS **3 0 2 4**

Course Objectives

- To familiarize with the physical properties of materials
- To gain practical applications of modern spectroscopy and microscopy techniques
- To understand the preparation of bio and nanomaterials

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

1. identify the electrical and thermal properties of conducting and semiconducting materials
2. analyze the various polarization mechanisms in dielectrics
3. choose specific materials for optical and magnetic data storage devices
4. investigate the specimen with the aid of suitable spectroscopic techniques
5. realize the methods adopted for preparing nano materials

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2													
3	1													
4	3													
5	2													

UNIT I **10 Hours**

CONDUCTING AND SEMICONDUCTING PROPERTIES

Quantum free electron theory - Fermi-Dirac distribution function - effect of temperature on Fermi function - density of energy states - calculation of density of electrons and Fermi energy at 0 K. Intrinsic semiconductors: expressions for density of electrons and holes - intrinsic carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in n-type and p-type semiconductors - variation of Fermi level with temperature and impurity concentration - problems.

UNIT II **9 Hours**

DIELECTRIC PROPERTIES

Introduction: fundamental definitions in dielectrics - types of polarization - expressions for electronic and ionic polarization mechanisms - orientation polarization (qualitative) - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric loss - dielectric breakdown mechanisms - active dielectric materials - applications of dielectric materials - problems.

UNIT III **10 Hours**

OPTICAL AND MAGNETIC PROPERTIES

Optical properties: introduction - light interaction with solids - atomic and electronic interactions - optical properties of metals, semiconductors and insulators - reflection - refraction - absorption - transmission - luminescence and photoconductivity. Magnetic properties: introduction - origin of magnetic moment - properties of dia, para and ferro magnetic materials - domain theory and hysteresis effect - hard and soft magnetic materials - problems.

UNIT IV **8 Hours**

SPECTROSCOPY AND MICROSCOPY TECHNIQUES

Introduction: different types of spectroscopy techniques - basic principle of FTIR spectroscopy and X-ray Photoelectron Spectroscopy (XPS). Basic principle and working mechanisms of Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - Atomic Force Microscope (AFM).

UNIT V **8 Hours**

BIO AND NANO MATERIALS

Biomaterials: classification of biomaterials - development of biomaterials - applications. Nanomaterials: properties - synthesis of nanomaterials - top-down approach: ball milling technique - bottom-up approach: Chemical Vapour Deposition (CVD) - uses of nanomaterials. Carbon nanotubes: properties and applications.

FOR FURTHER READING

Health and environmental impacts

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering An Introduction, John Wiley and Sons, Inc, 2010.
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
3. Jacob Milliman, Christos Halkias, Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
4. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
5. Subbiah Pillai, Nanobiotechnology, MJP Publishers, 2010.
6. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley-VCH, 2013.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	4	2		2	5	2		2	2			1	1											22
2	2		2		2		2		5	3			4												20
3	2		2		3	3	2		3	3			2	2											22
4	1	2	1		3	3			3	3			2												18
5	2	2			3	2	3		2				2	2											18
																								Total	100

Assessment Questions

Remember

1. Recall the merits of quantum free electron theory over classical free electron theory
2. Define carrier concentration
3. Recall Fermi energy
4. List the four types of polarization mechanisms.
5. Recognize polar and non-polar molecules

6. Define Bohr magneton
7. Recall coercivity and retentivity
8. Point out the four salient features of biomaterials
9. Define bioactive materials
10. State the working principle of FTIR spectroscopy

Understand

1. Classify three types of materials based on bandgap energy
2. Explain fermi-distribution function and effect of temperature on Fermi function
3. Represent the variation of Fermi level with temperature
4. Explain intrinsic and thermal breakdown mechanisms
5. Infer the importance of Fermi level in a semiconductor
6. Illustrate the phenomenon of B-H hysteresis on the basis of domain theory
7. Classify four types of biomaterials
8. Represent the scanning electron microscope to determine the grain size of the nanomaterials
9. Explain the principle, construction and working of Scanning electron microscope
10. Explain the principle and working mechanism of X – ray photoelectron spectroscopy (XPS)

Apply

1. Find the variation of Fermi level with temperature and impurity concentration in n-type semiconductors
2. Show that electronic and ionic polarizabilities are independent of temperature
3. Show that the position of Fermi level is exactly at the midpoint of forbidden energy gap in intrinsic semiconductor
4. Compute the relationship between polarizability and electric flux density.
5. Show that top down method is inferior to bottom up method
6. Construct B-H Hysteresis curve on the basis of domain theory
7. Design the principle, construction and working of chemical vapour deposition.
8. Show that the electronic polarizability is directly propotional to the volume of an atom
9. Compute the expression for carrier concentration in intrinsic semiconductors

Analyse

1. Extrinsic semiconductors possess high electrical conductivity than intrinsic semiconductors. Justify
2. Silver is the best conductor of electricity. But gold is used in high-end electronic connectors. Justify.
3. Identify the role of impurity concentration in the variation of Fermi level in the case of p-type semiconductors.
4. Compare polar dielectrics with non-polar dielectrics.
5. Analyse the features of hard and soft magnetic materials.
6. Compare the six properties of dia, para and ferro magnetic materials
7. Differentiate top down approach from bottom up approach.
8. Justify the electronic polarizability of Argon is much greater than that of Helium.
9. Intrinsic semiconductors are insulators at 0K. Justify.

15PH205 SOLID STATE PHYSICS 3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To understand the working mechanism of junction diodes
- To impart knowledge in optical and magnetic materials

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

1. identify different types of emission of electrons and significance of Fermi function
2. explore the carrier concentration and its variation with temperature of different semiconducting materials
3. analyze the I-V characteristics of a junction diode
4. investigate the various polarization mechanisms in dielectrics
5. select appropriate optical and magnetic materials for data storage devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2													
3	1													
4	2													
5	1													

UNIT I **10 Hours**

EMISSION PROPERTIES AND QUANTUM THEORY OF SOLIDS

Emission of electrons: types thermionic emission-principle- Richardson equation- secondary emission-principle- work function- Fermi-Dirac distribution function and its temperature dependence significance of Fermi energy- density of energy states- calculation of density of electrons and Fermi energy at 0K- average energy of electrons at 0K problems.

UNIT II **9 Hours**

SEMICONDUCTOR PHYSICS

Intrinsic semiconductors: the law of mass action - expressions for density of electrons and holes - determination of carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in p-type and n-type semiconductors. Hall effect: theory - experimental determination of Hall voltage - applications - problems.

UNIT III **9 Hours**

JUNCTION DIODE CHARACTERISTICS

Introduction - pn junction diode - volt-ampere characteristics - diode current equation - static and dynamic resistances - space charge - diffusion capacitance - junction diode switching times. Diode circuit with DC voltage source. Applications: full wave rectifier - capacitor filters - clamper circuits.

UNIT IV **9 Hours**

DIELECTRICS

Introduction: fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin Debye equation - frequency and temperature effects on polarization - expression for internal field (cubic structure) - Clausius-Mosotti equation - dielectric loss - applications of dielectrics - problems.

UNIT V **8 Hours**

OPTOELECTRONICS AND MAGNETIC MATERIALS

Principle, working and characteristics of LED and LCD - blue ray disc. Magnetic materials: basic definitions - properties of dia, para and ferro magnetic materials - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials. Magnetic storage device: principle - working - giant magnetoresistance.

FOR FURTHER READING

Motion of an electron in uniform and non-uniform magnetic fields - electric and magnetic fields in a crossed configuration.

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Jacob Millman, Christos Halkias and Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
2. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and sons, Inc, 2010.
3. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
4. R. S. Sedha, A textbook of Applied Electronics, S. Chand & Company Ltd., New Delhi, 2010.
5. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010
6. M. N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	2	2		2	4	2		2	5			2												22
2	2	2			2		3		2	3					6										20
3	2		1		3		2		5				2	2				3							20
4	2	2	2		2	3			2	5			2												20
5	2	2			3	2	2		2				5												18
																								Total	100

Assessment Questions

Remember

1. Recall the Richardson equation.
2. Define dynamic resistance.
3. State the law of mass action.
4. Define Hall Effect.
5. List the three practical applications of p-n junction diode.
6. List the three practical applications of p-n junction diode.
7. List the four types of polarizations in dielectrics
8. Reproduce the expressions for electronic and ionic polarization.
9. State the working principle of LED.
10. Define retentivity and coercivity.

Understand

1. Explain the variation of Fermi-Dirac distribution function with temperature.
2. Indicate the importance of Fermi level.
3. Indicate the reason for preferring extrinsic semiconductors over intrinsic semiconductors.

4. Represent four applications of Hall Effect.
5. Represent the switching action of a diode.
6. Interpret the relation between polarization and polarisability in dielectrics.
7. All the dielectrics are insulators but all the insulators are not dielectrics. Illustrate with examples.
8. Interpret the relation between the dielectric constant and electric susceptibility.
9. Explain the phenomenon of electroluminescence in LED.
10. Summarize the working principle of giant magnetoresistance.

Apply

1. Find the expression for density of electrons and Fermi energy at 0 K.
2. Using the Fermi function, compute the temperature at which there is 1% probability that an electron in a solid will have energy 0.5 eV above EF of 5 eV.
3. Explain how phosphorous atoms donate electrons to the conduction band.
4. Apply the law of mass action to determine the carrier concentration of intrinsic semiconductors.
5. Construct a circuit using p-n junction diode and execute its V-I characteristics.
6. Construct a diode circuit with DC voltage source and demonstrate its working conditions.
7. Show that electronic polarizability is independent of temperature.
8. Explain frequency dependence of dielectrics with a neat sketch.
9. Apply the domain theory to the hysteresis effect observed in ferromagnetic materials.
10. Compute the wavelength of light emitted by an LED with band gap energy of 1.8 eV.

Analyse

1. The average energy of electrons at 0 K depends on Fermi level. Justify.
2. Differentiate p-type and n-type semiconductors.
3. Outline the working principle of full wave bridge rectifier.
4. At optical frequencies the total polarization is less. Justify.
5. Outline the causes for dielectric loss in dielectric materials.
6. Analyze the magnetic behavior of dia, para and ferromagnetic materials.
7. Compare the properties of LED and LCD.
8. Outline the difference between hard and soft magnetic materials.

Evaluate

1. Evaluate the resistance value using V-I characteristics of a p-n junction diode.
2. Evaluate the value of Fermi distribution function for an energy kT above the Fermi energy at that temperature and comment on the answer.

15CH201 ENGINEERING CHEMISTRY 3 0 2 4

Course Objectives

- Recall the terminologies of electrochemistry and explain the function of batteries and fuel cells with its electrochemical reactions
- understand the fundamentals of corrosion, its types and polymers with its applications
- choose appropriate instrumentation technique for interpreting analytical data

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. construct an electrochemical cell and measure its potential using selected reference electrode
2. identify the electrodes, electrolyte and cell reactions in batteries, fuel cells and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion control method
4. differentiate polymers based on its source, properties and applications
5. Select suitable analytical method for the estimation of alkali and alkaline earth metals in aqueous media

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	2													
3	3	2		1										
4	2	2												
5	3	3		1										

UNIT I **10 Hours**

INTRODUCTION TO ELECTROCHEMISTRY

Types of electrodes - electrode potential - salt bridge - cell reaction - cell representation - silver-silver chloride electrode - calomel electrode - determination of single electrode potential - electrochemical series and its importance. Ion-selective electrode: glass electrode - measurement of pH using glass electrode. Concentration cells (electrode and electrolyte). Potentiometry - potentiometric titrations (redox titration). difference between electrochemical and electrolytic cells

UNIT II **9 Hours**

ENERGY STORAGE DEVICES

Batteries - characteristics of battery - types of batteries. construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Comparison with conventional galvanic cells. Fuel cells - Types of fuel cells: solid polymer electrolyte fuel cell - solid oxide fuel cells - microbial fuel cell. Hydrogen-oxygen fuel cell - construction, working, advantages and limitations

UNIT III **8 Hours**

CORROSION SCIENCE

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion - Pilling-Bedworth ratio - types of oxide layer (stable, unstable, volatile and porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current cathodic protection method - electroplating - electroless plating

UNIT IV **10 Hours**

POLYMERS AND ITS PROCESSING

Advantages of polymers over metals. Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications - Molecular weight determination. Types of polymerization: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (polyvinyl chloride and polytetrafluoroethylene). Compounding of plastics - injection and extrusion moulding methods

UNIT V **8 Hours**

INSTRUMENTATION TECHNIQUES FOR CHEMICAL ANALYSIS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: UV-visible spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of a transition metal) - Flame photometry (estimation of an alkali metal)

FOR FURTHER READING

Nobel prize winners in chemistry over past 5 years

1 **2 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and M/10 sodium carbonate solution.

2 **4 Hours**

EXPERIMENT 2

Determination of strength of hydrochloric acid present in the given solution by pH measurement.

3 **4 Hours**

EXPERIMENT 3

Determination of strength of HCl by conductometric titration.

4 **4 Hours**

EXPERIMENT 4

Conductometric titration of mixture of acids (Hydrochloric acid and acetic acid).

5 **4 Hours**

EXPERIMENT 5

Estimation of iron in the given sample by potentiometric method using saturated calomel electrode.

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on zinc/mild steel in aerated neutral/acidic/alkaline solution by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method.

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008.
5. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		3	4	2			4	4				1			2							23
2	1	1	1		4	4	3		1	2				1	2										20
3	1	1	1		2	2	1			2	2			2	1			1				1			17
4	5	3	2		3	1	1		1				1	2	2		1	1							23
5	1					3					3				7			2				1			17
																								Total	100

Assessment Questions

Remember

1. List any four significances of EMF series.
2. Define the term single electrode potential.
3. Recall the four advantages of H2-O2 fuel cell.
4. Define the term functionality of a monomer.
5. State Pilling-Bedworth rule.
6. Name two monomers used for the preparation of epoxy resin.
7. Label the parts and charge carried by electrodes in electrochemical and electrolytic cells.
8. List any two significances of monomer functionality.
9. State Beer - Lamberts law.
10. Define concentration cell.

Understand

1. Classify two types of polymers based on source.
2. Compare electrochemical cell and electrolytic cell with suitable diagrams.
3. Illustrate the mechanism involved in electrochemical corrosion.
4. Explain the principle and five components of UV-visible spectrophotometer.
5. Outline the mechanism for the synthesis of –(CF2-CF2)n– polymer.
6. Identify any two analytical methods to estimate sodium present in aqueous media.
7. Illustrate the injection molding process with a necessary explanation and two advantages.
8. Indicate any two importance of salt bridge in an electrochemical cell.
9. Ilustrate the route to synthesis epoxy resin from its two monomers.
10. Summarize any four advantages of polymers over metals in everyday life.

Apply

1. Calculate the single electrode potential value zinc half-cell dipped in a 0.01M ZnSO4 solution at 25°C? E° Zn/Zn 2+ = 0.763 V, R=8.314 JK -1 Mol -1 , F= 96500 Coulombs.
2. Identify two advantages of degree of polymerization.
3. Find the concentration of given solution using spectrophotometer, if %T, bath length and molar adsorptionÂ coefficient are 18, 1 cm and 6000 L/mol. cm.
4. Derive an equation for determination pH of unknown solution using glass electrode.
5. Elaborate the six applications of electrochemical series.
6. Select and explain suitable potentiometric titration to estimate the amount of ferrous ion in the given solution.
7. Discuss the construction and working of electrolyte concentration cell with suitable example.
8. Assess the significances of monomer functionality in the properties and structure of polymer.

Analyse

1. Outline any two methods for preventing chemical and electrochemical corrosion.
2. Compare the advantages and limitations of electro and electroless plating of nickel.
3. The statement "prevention is better than cure" is not suitable for corrosion science and engineering-Justify the answer in your own words.
4. Differentiate addition and condensation polymers based on its synthesis.
5. Arrange the following polymers based on the increasing order of resistance towards chemical
   1. poly(ethylene) 2. Starch 3.Baklite 4.Teflon

Evaluate

1. Calculate the electrode potential of zinc metal if EMF of the cell is 1.10 V (Sat. Calomel electrode was used for complete cell formation.
2. Electrode potentials of A and B are E 0 A/A+ = +0.76 V and E 0 B/B+ = -0.34 V respectively. Choose the appropriate anode half-cell and cathode half-cell by giving the cell representation
3. Find out the degree of polymerization for a low density polytetrafluoroethylene with a molecular weight of 10002 amu. (Atomic weights of F=18.9; C=12)
4. The standard reduction potentials of metals Ag, Fe, Cu and Zn are +0.80v,-0.44v, +0.34v and -0.76v respectively. Arrange the metals in the increasing order of their ability to undergo corrosion.

Create

1. A ship hull in ocean is safe against corrosion under any circumstance - Argue.
2. Derive the probable reason and possible solution for the following:
   i. Stainless steel should not be used to build ship hull.
   ii. Small anodic area results in intense corrosion.
   iii. Metal under water drop undergoes accelerated corrosion.

15CH202 APPLIED CHEMISTRY 3 0 2 4

Course Objectives

- understand the necessity of water softening processes
- aware the causes and consequences of corrosion
- acquaint the applications of alloying and phase rule in metallurgy
- recognise the fundamentals and applications of fuels
- characterize the chemical compounds using analytical techniques.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Analyze the type of corrosion, factors influencing rate of corrosion on metals and corrosion control methods
3. Differentiate ferrous and non ferrous alloys based on its properties, applications and illustrate the importance of phase rule in the field of mettallurgy
4. Distinguish the three types of fuels based on calorific value for selected applications
5. Apply suitable analytical methods for the estimation of elements in aqueous media

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		1										
2	2	3												
3	1	2												
4	2	1												
5	2	3		1										

UNIT I **10 Hours**

WATER PURIFICATION

Hardness of water - classification of hardness (temporary and permanent) - units of hardness (ppm, mg/l, degree Clark, degree French) - expression of hardness in terms of calcium carbonate equivalence - estimation of hardness by EDTA Method - Uses of water for industrial purpose - requirements of boiler feed water - disadvantages of using hard water in industrial boilers: scale, sludge, priming, foaming and caustic embrittlement. Removal of dissolved salts from hard water: internal conditioning (phosphate, carbonate, calgon and colloidal methods), external conditioning (ion exchange process, reverse osmosis, electrodialysis). Uses of water for domestic purpose - municipal water treatment (screening, aeration, coagulation, sedimentation, filtration and disinfection of water - break point chlorination).

UNIT II **8 Hours**

CORROSION SCIENCE

Corrosion - chemical and electrochemical corrosion - Pilling-Bedworth rule - mechanism (types of oxide layer, oxygen absorption - hydrogen evolution) - Galvanic series -types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline and waterline)-Factors influencing corrosion (nature of metal and environment). Corrosion control: sacrificial anode - impressed current method. Protective coatings - paint -constituents and functions.

UNIT III **9 Hours**

ALLOYS AND PHASE RULE

Alloys: purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys. Ferrous alloys: nichrome and stainless steel. Non-ferrous alloys: brass and bronze. Heat treatment of alloys (annealing, hardening, tempering, normalising, carburizing and nitriding). Phase rule: phase - component - degree of freedom - phase rule - phase diagram - applications- one component system (water system). Reduced phase rule - two component system (lead and silver system).

UNIT IV **10 Hours**

FUELS

Classification - characteristics - calorific value - solid fuel - coal - types - analysis of coal (proximate and ultimate analysis) - processing of coal to coke - carbonization - types (low temperature and high temperature carbonization) - manufacture of metallurgical coke (Otto Hoffmann method). Liquid fuels - petroleum - refining of crude oil - knocking - octane number - cetane number. Liquid fuel from coal (Bergius process). Gaseous fuels - natural gas (CNG) - coal gas - producer gas - syn gas - shale gas.

UNIT V **8 Hours**

INSTRUMENTAL METHODS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - Infrared spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of transition metal) - Flame photometry (estimation of alkali metal).

FOR FURTHER READING

Synthesis and applications of bio-fuels.

1 **2 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and N/10 sodium carbonate solution.

2 **4 Hours**

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH.

3 **4 Hours**

EXPERIMENT 3

Conductometric titration of mixture of acids (HCl CH3COOH).

4 **4 Hours**

EXPERIMENT 4

Determination of strength of hydrochloric acid in a given solution using pH meter.

5 **4 Hours**

EXPERIMENT 5

Determination of the strength of Fe(II) in the given sample by potentiometric method.

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on mild steel in aerated / neutral / acidic / alkaline medium by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Estimation of copper content in brass by EDTA method.

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method.

Total: 75 Hours

Reference(s)

1. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
2. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
3. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.
4. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishers New Delhi, 16th Edition, 2013.
5. R. Mukhopadhy and S. Datta, Engineering Chemistry, New age international Pvt. Ltd, New Delhi, 2010.
6. Shashi Chawla, Engineering Chemistry, Dhanpat Rai Publishers New Delhi, 2nd Edition, 2003.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		3	4	2		1	4	4				1			1							23
2	1	1	1		2	2	1		1	2	2			2	1			1							17
3	1	1	1		4	4	3		1	2					2							1			20
4	5	3	2		3	1	1		1	1			1	2	1		1	1							23
5	1					3					3				7			2				1			17
																								Total	100

Assessment Questions

Remember

1. Define the term hardness of water.
2. List any two internal conditioning methods to convert hard water to soft water.
3. List the two types of electrochemical corrosion.
4. Recall any two reasons for galvanic corrosion.
5. List the four major objectives of alloying steel.
6. State Gibbs phase rule.
7. Define octane number.
8. State Beer-Lambert’s law.
9. Recall any four applications of colorimetry.

Understand

1. Compare temporary and permanent hardness in water.
2. Illustrate the estimation of carbonate, non-carbonate and total hardness by EDTA method.
3. Identify the needs of corrosion control methods with suitable examples.
4. Indicate the two suitable conditions for electrochemical corrosion to occur.
5. Classify the three types of alloys based on metal composition.
6. For one component water system, the triple point is an invariant point. Reason out.
7. Distinguish between syn gas and coal gas.
8. With a neat diagram, explain the processes involved in Bergius process to get synthetic petrol.
9. Diiferentiate chromophore and auxochrome with an example.
10. Infer the role of ammonium thiocyanate in the colorimetric estimation of iron.

Apply

1. Illustrate the necessary steps involved in municipal water treatment..
2. Suggest a suitable laboratory method to estimate carbonate, non-carbonate and total hardness of water.
3. Sketch a suitable protection method to prevent ship's hull made of iron from corrosion.
4. Assess the effects of alloying elements.
5. Apply Gibbs phase rule for one component water system with a neat diagram.
6. Find the combusted products of the following components.
   (i) 2H2 (ii) CH4
7. Find the application of colorimetry for the estimation of iron.
8. Calculate the number of the modes of vibrations for the following molecules.
   (i) C6H6 (ii) CO2

Analyse

1. How can the effect of caustic embrittlement in boiler be resolved?
2. Identify the problems created in boilers if priming and foaming takes place.
3. Increase in temperature increases corrosion rate. Justify.
4. Zinc is more corroded when coupled with copper than lead – Reason out.
5. Distinguish ferrous and non-ferrous alloys with examples.
6. Arrange the following materials based on their increasing calorific value.
   peat, lignite, bituminous, wood, anthracite and sub-bituminous.

Evaluate

1. Bolt and nut made of the same metal is preferred in practice. Give reason.
2. Support the statement "Coke is a better fuel than coal".
3. Calculate the absorbance if 10% of light is transmitted.
4. Determine the effect of pH of the conducting medium on corrosion.
5. Determine the number of phases present in the following systems.
   (i) Two miscible liquids (alcohol & water)
   (ii) Two immiscible liquids (benzene & water)

Create

1. Derive the probable reason and possible solution for the following:
   i) Stainless steel should not be used to build ship hull.
   ii) Small anodic area results in intense corrosion.
   iii) Metal under water drop undergoes accelerated corrosion.
2. AAS is a better method for environmental analysis than calorimetric analysis. Justify.

15CH203 APPLIED ELECTROCHEMISTRY 3 0 2 4

Course Objectives

- Understanding the basic concepts of electrochemistry and their application
- Expanding knowledge about corrosion and methods of control
- Gaining information regarding principle, working and application of batteries and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Construct an electrochemical cell and calculate its cell potential.
2. Measure the emf of a cell using different electrodes.
3. Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.
4. Differentiate types of corrosion and its prevention by suitable techniques.
5. Recognize the importance of fuel cells and solar battery.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	3												
3	2	1												
4	2	2												
5	3	1												

UNIT I **9 Hours**

FUNDAMENTALS OF ELECTROCHEMISTRY

Introduction - electrical conductance in solution - electrical double layer - electrode potential - importance of electrode potential. Electrochemical cell - standard cell: Weston cadmium cell - Concentration cell: electrode and electrolyte - applications. Applications of electrolytic cells: electrolysis of water, electrolysis of brine and electroplating of copper and gold

UNIT II **9 Hours**

REFERENCE ELECTRODES

Primary and secondary reference electrodes - metal-metal ion electrode, metal-metal insoluble salt electrodes: silver-silver chloride electrode, calomel electrode - ion-selective electrode: glass electrode - measurement of pH of a solution using glass electrode. Quinhydrone electrode: construction - advantages - limitations. Applications of EMF measurements: Potentiometric titrations: acid-base titration - oxidation-reduction titration - precipitation titration

UNIT III **10 Hours**

ENERGY STORING DEVICES

Types of batteries - alkaline, lead-acid, nickel-cadmium and lithium batteries - construction, working and commercial applications. Electrochemical sensors. Decomposition potential: variation of decomposition potential for different metals - importance of decomposition potential. Over voltage: factors affecting over voltage value. Maintenance and precautions in battery handling

UNIT IV **10 Hours**

CORROSION SCIENCE

Corrosion - causes - dry and wet corrosion - Pilling-Bedworth rule - mechanism (hydrogen evolution and oxygen absorption) - rusting of iron. Galvanic series - applications. Galvanic corrosion - differential aeration corrosion (pitting, waterline and stress) - factors influencing corrosion. Corrosion control - sacrificial anode and impressed current cathodic protection methods - Metallic coatings: chromium plating - nickel plating - galvanizing and tinning

UNIT V **7 Hours**

FUEL CELL AND SOLAR BATTERY

Introduction - types of fuel cell: low, medium and high temperature fuel cell. Hydrogen-Oxygen fuel cell - advantages. Solid polymer electrolyte fuel cell, solid oxide fuel cells, biochemical fuel cell. Solar battery - domestic, industrial and commercial applications. Environmental and safety issues

FOR FURTHER READING

Document the various batteries with its characteristics used in mobile phones and laptops Maintenance free batteries, Battery recycling

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions.

2 **4 Hours**

EXPERIMENT 2

Determination of strength of a commercial mineral acid by conductometric titration.

3 **4 Hours**

EXPERIMENT 3

Electroplating of copper onto a stainless steel object.

4 **4 Hours**

EXPERIMENT 4

Determination of strength of iron in a given solution by potentiometric method.

5 **4 Hours**

EXPERIMENT 5

Determination of amount of hydrochloric acid present in the given sample using pH meter.

6 **4 Hours**

EXPERIMENT 6

Conductometric titration of mixture of acids.

7 **4 Hours**

EXPERIMENT 7

Determination of corrosion inhibition on mild steel using natural inhibitors.

8 **4 Hours**

EXPERIMENT 8

Estimation of barium by precipitation titration.

Total: 75 Hours

Reference(s)

1. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010.
2. B. S. Chauhan, Engineering Chemistry, 3rd Edition, Laxmi Publication Ltd, New Delhi, 2010.
3. B. R. Puri, L. R. Sharma and Madan S Pathania, Principles of physical chemistry, 46th Edition, Vishal publishing Ltd, New Delhi, 2013.
4. B. S. Bahl, G. D. Tuli and Arun Bahl, Essentials of Physical Chemistry, 5th Edition, S. Chand & Company, New Delhi, 2012.
5. S. Vairam, Engineering Chemistry, 1st Edition, John -Willy, India private limited, New Delhi, 2014.
6. Sashi Chawla, Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	1	1			2	1		1	1	2			2	1			1	1		20
2	1	4			2	4	1			2			1	2				1	2						20
3		1	1		4	5			2	4			2	1			1	2							23
4	2	1			2	5	1			3				2			2	2				2			22
5	2	2			1	4			2	1			1	1				1							15
																								Total	100

Assessment Questions

Remember

1. List any two advantages of hydrogen oxygen fuel cells.
2. Name any two secondary batteries used in electronic appliances.
3. State pilling bedworth rule.
4. List any two applications of lithium battery.
5. Define overvoltage.
6. Recall the two limitations of quinhydrone electrode.
7. List the three major applications of galvanic series.
8. Recall the term redox reaction.
9. Define standard electrode potential.

Understand

1. Identify any two factors affecting the rate of corrosion based on the nature of metal.
2. Compare solar battery with lead acid-battery with respect to cell reactions, advantages and limitations.
3. Explain the working of hydrogen-oxygen fuel cell with necessary diagram and cell reactions. Mention its two advantages and limitations.
4. Explain the difference between galvanic and differential aeration corrosion with an example each.
5. Summarize any five factors that affect overvoltage value of a cell.
6. Differentiate cell from battery.
7. Sketch and explain the construction and working of saturated calomel electrode with necessary cell reactions.
8. With a neat sketch explain the working of a silver – silver chloride electrode.
9. Elucidate the working principle of Weston cadmium cell with suitable cell reactions.
10. Distinguish galvanic and electrolytic cells based on cell reactions.

Apply

1. Assess the six advantages of solid polymer electrolyte fuel cell.
2. Many metals form oxide layer when exposed to atmospheric conditions due to corrosion. Predict the four types of metal oxide layers formed with two examples each.
3. An iron pipe line buried under soil is used to carry natural gas, suggest any two corrosion control techniques that can be employed to minimize/control corrosion.
4. Predict the type of corrosion taking place when a piece of iron rod is exposed to moisture and explain the mechanism of rust formation.
5. Illustrate the construction of 6V lead-acid battery and explain its functioning during discharging and charging process.
6. Select a suitable secondary storage battery used in mobile phones. Explain its reactions during charging and discharging process.
7. Find the electrode potential of zinc rod using saturated calomel electrode as reference electrode (E cell value is 1.10 V).
8. Apply the principle of ion selective electrode to find the pH of HCl solution using glass electrode with necessary equations.
9. Can we use KCl salt bridge to construct a cell using Ag and Pb half-cell. Give reason.
10. Identify a suitable technique to achieve copper coating on stainless steel object with a neat diagram.

Analyse

1. Can you store zinc sulphate solution in a copper container? Give reason if your answer is yes/no.
2. Predict why copper cannot displace hydrogen from mineral acid solution.
3. Represent diagrammatically an electrochemical cell that produces 1.1 volt as an output. Write the half-cell reactions responsible for that.
4. Zinc corrodes at a faster rate when coupled with copper than lead. Give reason.
5. Does the water exhaust from hydrogen - oxygen fuel cell is drinkable? Give reasons if Yes/No.

Evaluate

1. Electrode potentials of A and B are E0A/A+ = +0.76 V and E0B/B+ = -0.34 V respectively. Choose the appropriate anode half-cell and cathode half-cell by giving the cell representation.
2. Glass electrode cannot be used in solutions having pH greater than 9.0. Give reason.
3. As an engineer, which type of metal oxide forming metal you will choose for your design? Reason out.

4. The standard reduction potentials of metals Ag, Fe, Cu and Zn are +0.80v,-0.44v, +0.34v and -0.76v respectively. Arrange the metals in the increasing order of their ability to undergo corrosion.
5. Identify any two advantages of microbial fuel cell over lead acid battery.

Create

1. Derive the probable reason and possible solution for the following:
   i) Stainless steel should not be used to build ship hull.
   ii) Small anodic area results in intense corrosion.
   iii) Metal under water drop undergoes accelerated corrosion.
2. As an engineer, which type of metal oxide forming metal you will choose for your design? Reason out.

3 0 2 4

15CH204 INDUSTRIAL CHEMISTRY

Course Objectives

- impart knowledge on the principles of water characterization, treatment methods and industrial applications
- understand the principles and application of electrochemistry, fuel and combustion
- recognize the fundamentals of polymers, nano chemistry and analytical techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. identify the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. utilize the concepts of electrochemistry in real time applications.
3. realise the importance of fuel chemistry in day to day life.
4. differentiate the polymers used in day to day life based on its source, properties and applications
5. familiarize with the synthesis and characterization techniques of nanomaterials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	1	2												
3	3	1												
4	2	1												
5	2	2												

UNIT I **10 Hours**

WATER PURIFICATION TECHNOLOGY: SOFTENING AND DESALINATION

Hardness of water: Equivalents of calcium carbonate - Units of hardness - Degree of hardness and estimation (EDTA method). Use of water for industrial purposes: Boiler feed water-scale-sludge -priming and foaming -caustic embrittlement. Softening of hard water: External conditioning - ion exchange methods - Internal conditioning - trisodium, dihydrogen, trihydrogen phosphate and sodium hexameta phosphate- carbonate- colloidal methods. Desalination: Reverse osmosis - electrodialysis. Domestic water treatment - Disinfection of water - break point chlorination

UNIT II **10 Hours**

ELECTROCHEMISTRY

Introduction - EMF - Single electrode potential -Calomel electrode - Glass electrode -pH measurement using glass electrode - Electrochemical series. Cells: Electrochemical cells - Cell reactions- Reversible cells and irreversible cells. Batteries - characteristics of battery - types of batteries, construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Fuel cell: Hydrogen - Oxygen fuel cell.Electroplating of copper and electroless plating of nickel

UNIT III **8 Hours**

FUELS AND COMBUSTION

Fuel: Introduction - classification of fuels - calorific value - higher and lower calorific values - analysis of coal (proximate and ultimate) - carbonization - manufacture of synthetic petrol (Bergius process) - knocking - octane number - cetane number - natural gas - Compressed Natural Gas (CNG)- Liquefied Petroleum Gases (LPG) - producer gas - water gas. Combustion of fuels: introduction- theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - ignition temperature

UNIT IV **9 Hours**

POLYMER AND COMPOSITES

Monomers - functionality - degree of polymerizations - classification of polymers based on source and applications; porosity - tortuosity - molecular weight determination by Ostwald method - polymerization methods: addition, condensation and copolymerization - mechanism of free radical polymerization - thermosetting and thermoplastics. Polymer blends - composites, significance, blending-miscible and immiscible blends, phase morphology, fibre reinforced plastics, long and short fibre reinforced composites

UNIT V **8 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire -nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production - properties - applications. Working principle and applications - Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV-Visible spectrophotometer

FOR FURTHER READING

Application of nanomaterials in medicine, environment, energy, information and communication sectors

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

2 **4 Hours**

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH

3 **4 Hours**

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 **4 Hours**

EXPERIMENT 4

Determination of strength of a commercial mineral acid by conductometric titration

5 **4 Hours**

EXPERIMENT 5

Conductometric titration of mixture of acids

6 **4 Hours**

EXPERIMENT 6

Determination of the strength of iron in the given sample by potentiometric method

7 **4 Hours**

EXPERIMENT 7

Determination of molecular weight of polyvinyl alcohol by Ostwald viscometry method

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008
5. G. Cao, Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific, New Jersey, 2011
6. S. Sarkar, Fuels and combustion, 3rd edition, Orient Longman Ltd. New Delhi, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		2	4	3			1	3		1		3				1						21
2	2	1	2		2	5	2		1	1	3				1				1						21
3	1	2	2		1	3	3			2	2			1	1				1						19
4	1	1	1		3	4	1		1	1	3			1	2				1						20
5	1	1	1		1	2	2			2	3			2	2				2						19
																								Total	100

Assessment Questions

Remember

1. Define the term break point chlorination.
2. Name a method to prevent the scale formation in the industrial boilers.
3. Define single electrode potential of an electrode.
4. List any two advantages of H2-O2 fuel cell.
5. Define functionality of a monomer.
6. Name any two thermoplastic and thermosetting polymers.
7. List any two applications of SEM.
8. Recall any two application of X-Ray diffractometer.
9. List three factors which affects the standard electrode potential of cell.

Understand

1. Illustrate any three applications of electrochemical series.
2. Summarize the four applications of calorimeter.
3. Explain the components of TEM with a neat sketch.
4. Compare bottom up approach with top down approach of nanoparticle synthesis.
5. Distinguish between alkaline and non alkaline hardness.
6. Differentiate between thermoplastic and thermosetting plastics
7. Why copper cannot displace hydrogen from mineral acid solution?
8. Identify two significances of RO method in water treatment.
9. Indicate any two advantages of water gas over producer gas.
10. Compare nanocluster with nanocrystal.
11. Identify the reasons for change of properties of materials at nanoscale.

Apply

1. A water sample contains 204 mgs of CaSO4 and 73 mgs of Mg(HCO3)2 per litre. Calculate the total hardness in terms of CaCO3 equivalence.
2. 100 ml of sample water has hardness equivalent to 12.5ml of 0.08N MgSO4. Calculate hardness in ppm.
3. Find out the single electrode potential of a half cell of zinc electrode dipped in a 0.01M ZnSO4 solution at 25°C? E° Zn/Zn 2+ = 0.763 V, R=8.314 JK-1Mol-1, F= 96500 Coulombs.
4. Calculate the reduction potential of Cu2+/Cu=0.5M at 25°C. E° Cu 2+/ Cu= +0.337V.
5. Find out the weight and volume of air required for the complete combustion of 1 kg of coke.
6. A sample of coal containing 60% C, 6% H, 33% O, 0.5 % S, 0.2% N and 0.3% of ash. Find the gross and net calorific value of coal.
7. Calculate the degree of polymerization of polypropylene having molecular weight of 25200.
8. Apply the principle of ion selective electrode to determine the pH of HCl solution using glass electrode with equations.

Analyse

1. Calgon conditioning is advantageous over phosphate conditioning- reason out.
2. Soft water is not demineralized water whereas demineralized water is a soft water- Jusify.
3. Hydrogen electrode is not generally used for pH measurements – Why?
4. Zinc reacts with dil.H2SO4 to give hydrogen but silver doesn't liberate hydrogen. Give reasons.
5. Good fuel should have low ash content- Give reasons.
6. Sugar is an example of non-electrolyte - Reason out.

Evaluate

1. Hydrogen fuel is an ideal fuel for the future among all other fuels- Justify.
2. Choose a best method for water purification and explain their components.

15CH205 WATER TECHNOLOGY AND GREEN CHEMISTRY

3 0 2 4

Course Objectives

- Imparting the knowledge on the principles of water technology and green chemistry
- Understanding the principles and applications of green technology in water treatments
- Infer the engineering applications of green chemistry in dyes, corrosion engineering and nanotechnology

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. understand the importance of green chemistry with its emergence and development.
2. realize the designing of safer methodologies for green technology to meet the objectives of green engineering.
3. Identify the type of corrosion and its mechanism which will help to develop the corrosion control methods.
4. apply suitable technique to extract natural dye from its source.
5. familiarize with the synthesis and characterization techniques of nanomaterials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	3												
3	2	2												
4	1	3												
5	2	2												

UNIT I **9 Hours**

WATER TREATMENT

Water quality parameters - Hardness of water - Disadvantages of hard water - Degree of hardness and its estimation (EDTA method) - Boiler feed water - Boiler troubles: Priming, foaming and caustic embrittlement - Softening of hard water: Internal conditioning: Sodium hexameta phosphate - Phosphate methods; External conditioning: Ion exchange method - Desalination: Reverse osmosis - Electrodialysis. Domestic water treatment - Disinfection of water - Break point chlorination.

UNIT II **8 Hours**

WASTE WATER ANALYSIS

Basic principles and concept of green chemistry - Need of green chemistry in day-to-day life - Scientific areas for practical applications of green chemistry - Industrial effluents - Waste water analysis: Concept of chemical oxygen demand (COD) and biological oxygen demand (BOD) - Removal of trace pollutants in waste water: Membrane Bioreactor (MBR) technology - Wet oxidation method.

UNIT III **10 Hours**

CHEMISTRY OF CORROSION

Corrosion: Mechanism of corrosion - chemical and electrochemical - Pilling-Bedworth rule - oxygen absorption - hydrogen evolution - galvanic series. Types of corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline, water line and wire fence corrosion) - factors influencing corrosion. Methods of corrosion control: choice of metals and alloys - proper designing - cathodic protection (Sacrificial anode method, impressed current method)-modifying the environment. Protective coatings: Concept of electroplating: electroplating (gold and copper) - electroless plating (nickel and copper).

UNIT IV **9 Hours**

NATURAL DYES

Introduction - definition - classification of natural dyes - concept of chromophores and auxochromes - Extraction process of colour component from natural dyes: Aqueous extraction, non-aqueous extraction - Purification of natural dyes: Chromatography techniques - Types - Column chromatography - thin layer chromatography - Qualitative analysis: UV-Visible spectroscopic study - Mordant: Metallic and non-metallic mordant - advantages and disadvantages of natural dyes.

UNIT V **9 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire - nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production - properties - applications. Working principle and applications: Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV- Visible spectrophotometer. Synthesis of Au and Ag nanoparticles using plant extract - Advantages.

FOR FURTHER READING

Protection of metals in concrete against corrosion Microwave technology on green chemistry

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

2 **4 Hours**

EXPERIMENT 2

Water quality- river/bore well water with respect to hardness and TDS

3 **4 Hours**

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 **4 Hours**

EXPERIMENT 4

Estimation of strength of iron by potentiometric method using calomel electrode

5 **4 Hours**

EXPERIMENT 5

Extraction of a natural dye by aqueous extraction method

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion of mild steel in aerated neutral/acidic/alkaline solution by weight loss measurements/Tafel polarization method

7 **4 Hours**

EXPERIMENT 7

Determination of dye concentration in a given sample by using UV-Visible spectroscopic method

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. V K Ahluwalia, Green Chemistry - Environmentally Benign Reactions, Ane Books Pvt. Ltd., New Delhi, 2nd Edition, 2012
3. Giusy Lofrano, Green Technologies for Wastewater Treatment - Energy Recovery and Emerging Compounds Removal, Springer Dordrecht Heidelberg, New York, London, 2012
4. Ashis Kumar Samanta and Adwaita Konar, Natural Dyes - Dyeing of Textiles with Natural Dyes, Dr.Emriye Akcakoca Kumbasar (Ed.), InTech Publisher, New Delhi, 2011
5. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010
6. David Pozo perez, Nanotechnology and Nanomaterials, InTech Publishers, NewDelhi, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			3	3				3	3			2	2										20
2	2				3	4				2	2			2	2										17
3	1	2	1		4	3	3				3			1	2			2				1			23
4	1	2			6	6				3												2			20
5	3	2	2		3	6	2		2																20
																								Total	100

Assessment Questions
Remember

1. List out any four water quality parameters.
2. Name the salts responsible for temporary hardness of water.
3. Recall any two practical applications of green chemistry.
4. Define wet oxidation in waste water treatment.
5. State Pilling Bed-worth's rule.
6. Recall any two examples for differential aeration corrosion.
7. Name any two natural dyes.
8. Recall the role of auxochromes in dyes.
9. Name the four methods of nanomaterial synthesis.
10. Name any two plant extracts used in silver nanoparticles synthesis.

Understand

1. Hardness of water is always expressed in terms of CaCO3 equivalent. Reason out.
2. Soft water is not demineralized water whereas demineralized water is soft water - Justify.
3. Represent the need of green chemistry in waste water treatment.
4. Indicate the importance of MBR technology in waste water treatment.
5. Express the mechanism of wet corrosion.
6. Bolt and nut made from same metal is preferred in practice. Reason out.
7. Classify the types of natural dyes based on their chemical structure.
8. Compare the properties of metallic and non-metallic mordents.
9. Infer any two important needs of green chemistry in nanotechnology sector.
10. Identify the physicochemical and engineering properties of nanomaterials.

Apply

1. A sample of water contains 180 mgs of MgSO4 per litre. Calculate the hardness in terms of CaCO3 equivalents. (Molecular weight of MgSO4 is 120).
2. Calculate the non-carbonate hardness of a sample of water containing the dissolved salts as given below in mg/l Mg(HCO3)2 = 7.3; Ca(HCO3)2 = 40.5 and NaCl =50.
3. Select the scientific areas for the practical applications of green chemistry.
4. Predict the significance of sacrificial anode in the prevention of corrosion.
5. Outline the principle of electro-deposition to achieve copper coating on stainless steel object with a neat diagram.
6. Select a suitable technique used for the purification of natural dye.
7. Assess the role of Scanning Electron Microscope (SEM) in nano-materials characterization.

Analyse

1. Identify the four reasons for boiler troubles.
2. Differentiate between BOD and COD.
3. The rate of corrosion increases with increase in temperature. Give reason.
4. Outline the effect of pH of the conducting medium on corrosion.
5. Differentiate chromophores & auxochromes in dyes.

Evaluate

1. Substantiate the statement that nature of the environment affects corrosion..
2. Choose and explain any two best methods to synthesis nanoparticles.

Create

1. Plan and execute a method to get pure water from waste water using available low coast material in your area.
2. Relate the characteristic properties of natural with synthetic dyes.

15EI001 MICROCONTROLLER BASED SYSTEM DESIGN 3 0 0 3

Course Objectives

- To study the Architecture of 8051 and PIC Microcontroller
- To teach about the I/O ports and role of RTOS on microcontroller
- To impart knowledge on PIC Microcontroller and its interfacing with various pheripherals
- To give case study experiences for microcontroller based applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Design programs using 8051 microcontroller for various real time issues
2. Differentiate the conceptual knowledge between 8051 and RTOS
3. Study the architecture and design programs using PIC microcontroller
4. Interface PIC microcontroller with various peripheral devices
5. Analyze and propose suitable solutions to complex problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	2	2						1	1	
2	3	2	2	2	2	2						2	2	
3	3	2	2	2	2	2						2	2	2
4	3	2	2	2	2	2						2	2	2
5	3	2	2	2	2	2						2	2	2

UNIT I **9 Hours**

8051 ARCHITECTURE

Architecture - memory organization - addressing modes-instruction set - Timers - Interrupts - I/O ports, Interfacing I/O Devices - Serial Communication.

UNIT II **9 Hours**

8051 PROGRAMMING

Assembly language programming - Arithmetic Instructions-Logical Instructions - Single bit Instructions - Timer Counter Programming - Serial Communication Programming - Interrupt Programming - RTOS for 8051 - RTOSLite - FullRTOS - Task creation and run - LCD digital clock/thermometer using FullRTOS

UNIT III **9 Hours**

PIC MICROCONTROLLER

Architecture - memory organization - addressing modes -instruction set - PIC progrmming in Assembly & C - I/O Port, Data Conversion, RAM & ROM Allocation, Timer Programming , MP -LAB.

UNIT IV **9 Hours**

PERIPHERAL OF PIC MICROCONTROLLER

Timers - Interrupts, I/O ports - 2C bus - A/D converter -UART - CCP modules - ADC, DAC and Sensor Interfacing - Flash and EEPROM memories.

UNIT V **9 Hours**

SYSTEM DESIGN CASE STUDY

Interfacing LCD Display - Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control - Controlling DC/AC appliances - Measurement of frequency - Stand alone Data Acquisition System.

FOR FURTHER READING

Speed Control of DC motor using PIC microcontroller - Interfacing accelerometer with PIC microcontroller - Interfacing of rotatory encoder with ATMEGA2560

Total: 45 Hours

Reference(s)

1. John B Peatman, Design with PIC Micro controllers, Prentice Hall of India book Co, New Delhi, 2012.
2. Rajkamal, Microcontrollers - Architecture, Programming, Interfacing & System Design, 2nd,Pearson, 2012.
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ,PIC Microcontroller and Embedded Systems using Assembly and C for PIC18, Pearson Education 2012
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, Prentice Hall, 2005.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6				12			2									2			24
2	2				2	2			2						6						2				16
3		2				6				6	4		2	2								2			24
4		2			2	4			2					6							2	2			20
5		2			2	4				2	2				2						2				16
																								Total	100

Assessment Questions
Remember
1. List three main criteria to choose the microcontroller.
2. Define Flip-flop
3. Define timers and counters.
4. Define stack pointer
5. State the job of TMOD register
6. List three applications of RTOS
7. Define watchdog timer
8. Write down two importance of stack register.
9. Define PCLATH
10. List any four instruction set of PIC microcontroller.

Understand
1. Illustrate the architecture of 8051 microcontroller with neat sketch.
2. Summarize the different types of bus available in 8051
3. Explain the memory organisation 8051 microcontroller.
4. Explain and explain the terms a. SFR b. PSW c. PC .
5. Indicate the various addressing modes of 8051 microcontroller with suitable examples each.
6. Illustrate the block diagram of UART with neat sketch.
7. Represent the different capture modes available in the capture module of PIC.
8. Explain in detail how analog interfacing with PIC can be accomplished using the digital i/o of functions of PIC.
9. Identify the four step sequence of Stepper motor if we start with 0110.
10. Explain the case study for controlling of AC and DC appliances using microcontroller.

Apply
1. Construct a program to rotate the stepper motor clockwise / anticlockwise continuously with full step sequence.
2. Conclude on memory organization of a PIC microcontroller.
3. Design the PIC Timer Interrupts at the intervals:0.0, 1ms, 1.5 ms, 3.0 ms and this shall be repeated as long as MC is switched ON.
4. Demonstrate the working of RS-232 Serial communication.
5. Select a method to calculate duty ratio in PWM.
6. Develop interrupt facilities and programming techniques for RTOS.
7. Predict the importance of RTOS and its application with necessary diagrams?

Analyse
1. Differentiate between 8051 and PIC?
2. Differentiate microprocessor and microcontroller?

3. Identify a method to test a LCD whether it is ready or not to receive a command or data?
4. With necessary diagram, explain the case study of generation of gating signals for a single phase half controlled rectifier used to control speed of a DC Motor using any one controller.
5. Differentiate parallel and serial communication.
6. Justify why the crystal oscillator frequency in 8051Â is chosen as11.0592Mhz?

Evaluate

1. With necessary diagram, explain the case study of generation of gating signals for a single phase half controlled rectifier used to control speed of a DC Motor using any one controller.
2. Determine the calculation of baud rate for serial data transfer in mode 1

Create

1. Calculate the resolution of 10bit ADC having Max. having analog value +10 volt.
2. In key board interface, if RB7-RB4 =0111 is the data read from the columns, Which column does the pressed key belongs to.

15EI002 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES 3 0 0 3

Course Objectives

- To understand the process involved in petroleum refineries
- To impat adequate knowledge on the distillation column and its control process
- To understand the controlling concepts of major unit of refineries like distillation column, reactors ,driers, heat exchangers, etc.,
- To be acquainted with the safety measures in petroleum industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Explain the scenario of the production and consumption of fossil fuels in India
2. Compare the different types of control distillation process in petroleum industries
3. Analyse the characteristics of physical parameters and control mechanism in chemical reactors
4. Summarize the Process parameters of heat exchange system in petroleum industries
5. Infer the usage of safety instrumentation(zone 0, 1, and 2) to avoid the accidents in industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2		1									
2	2	3		3										
3	3		2		2									
4	2	2	1											
5	3	2			1									

UNIT I **7 Hours**

INTRODUCTION

Petroleum exploration, production and refining - refining capacity in India - consumption of petroleum products in India - constituents of crude oil.

UNIT II **10 Hours**

DISTILLATION PROCESS CONTROL

Introduction to P & I diagram - atmospheric distillation of crude oil with P&I diagram - Separation of crude oil - vacuum distillation process - thermal conversion process - control of distillation column - temperature control - process control - feed control - reflux control - reboiler control

UNIT III **9 Hours**

REACTORS PROCESS CONTROL

Control of chemical reactors: temperature control, pressure control - Dryers: control of dryers - batch dryers - atmospheric and vacuum dryers - continuous dryers

UNIT IV **10 Hours**

HEAT EXCHANGE SYSTEM

Control of heat exchangers and evaporators - variables and degrees of freedom - liquid to liquid heat exchangers - steam heaters - condensers - reboiler and vaporizers - cascade control - feed forward control - evaporators: types of evaporators

UNIT V **9 Hours**

SAFETY INSTRUMENTATION

Hazardous and non-hazardous area - classification of zone 0, zone 1 & zone 2 - pressurization techniques - zener barrier

FOR FURTHER READING

Stability of distillation column operation, Vacuum dryers, Case Study: Distillation process in Reliance Industries Limited & Bharat Petroleum Corporation ltd. (BPCL).

Total: 45 Hours

Reference(s)

1. Ram Prasad, Petroleum Refining Technology, Khanna Publishers Ltd, New Delhi, 2000
2. B.G. Liptak, Instrumentation in Process Industries, Chilton Book Company, New York,1973
3. B.G. Liptak, Instrument Engineers Handbook Volume II, 2003

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	14																			20
2	2	2			2	14																			20
3		2			2	2				12				2											20
4	2	2			2	14																			20
5		2				4				12				2											20
																								Total	100

Assessment Questions

Remember

1. Define Petrochemical-cum-refinery complex.
2. Define flooding.
3. Define degrees of freedom.
4. Define intrinsic safety.
5. List eight components that are used in drilling and explain its operation.
6. Define oil immersion protection method.
7. Define oil immersion protection method.
8. List the three types of hazardous area location.
9. Recall the importance of dryers in petrochemical industry.
10. State the use of Derrick.

Understand

1. List out the important commercial products obtained from petroleum.
2. Define coking.
3. Justify the process of oil and gas formation.
4. Indicate the need for reactors in chemical industry.
5. Sketch the diagram of horizontal tube evaporator.
6. Compare intrinsic and extrinsic safety method.
7. Classify the petroleum recovery techniques and explain each.
8. Compare the thermal cracking, visbreaking and coking process.
9. Classify the four types of evaporator and explain the working principle of falling film evaporator and short tube evaporator.
10. Explain in detail about the hazardous and nonhazardous areas.

Apply

1. Show the two types of chemical reactors used in industry.
2. Find the advanced heat-transfer controls used in heat exchanger.
3. Implement the zener barrier and pressurization hazard method in safety zone.
4. Design an advanced heat-transfer control used in heat exchanger.
5. Design the two different types of chemical reactors used in industry.
6. Find the reason for using safety valve in a stationary boilers.
7. Predict the reason for using water cooled refrigerator for counter flow measurement.
8. Implement the recovery method that injects stream or other gases and liquids to simulate oil flow.
9. Design a P&I diagram for temperature control.
10. Design a P&I diagram for vaccum distillation column.

Analyse

1. Differentiate light and middle distillate.
2. Differentiate on shore and off shore.
3. Justify the two variables used in thermal cracking process.
4. Compare adiabatic and non-adiabatic dryers.
5. Compare zone 1, zone 2 and zone 3 hazardous areas.
6. Differentiate on shore and off shore derrick used for petroleum exploration.
7. Justify the temperature control of reactors used in Oil industry.
8. Differentiate light and heavy distillate.
9. Compare adiabatic and non-adiabatic dryers.
10. Compare zone 0, zone 1& zone 2 hazardous areas in detail.

Create

1. Create a statistical report on petroleum consumption in India.
2. Create a list of oil refineries in India and create a data sheet about capacity of oil production

15EI003 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

3 0 0 3

Course Objectives

- To identify and model a linear and nonlinear system
- To impart knowledge on Parametric estimation and Recursive identification methods
- To understand the concept of Adaptive control schemes, Robustness and applications of adaptive control method.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Design transfer function, statespace, black box, fuzzy models for LTI and LTV systems by using System Identification procedure
2. Differentiate various parameter estimation methods (Linear regression, Least square estimation, prediction error methods etc..) for system modeling.
3. Organize various methods involved in recursive identification based system modeling
4. Develop adaptive control schemes (GSC, MRAC, STR) for given real time process
5. Identify and trouble shoot the issues in adaptive control schemes applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3											2
2	3	3	3											2
3	3	3	3											2
4	3	3	3											2
5	3	3	3											2

UNIT I **9 Hours**

MODELS FOR IDENTIFICATION

Models- System Identification procedure-Models of LTI systems: Linear Models -Transfer Function model- State space Models- Model sets, Structures and Identifiability-Models for Time-varying and Non-linear systems: Models with Non-linearities - Non-linear state-space models-Black box models, Fuzzy models.

UNIT II **11 Hours**

PARAMETER ESTIMATION METHODS

Linear regression - Least square estimation - prediction error methods - optimal prediction - Parameter Estimation - Maximum Likelihood methods - Instrumental variable methods: Description of instrumental variable methods - Input signal design for identification.

UNIT III **9 Hours**

RECURSIVE IDENTIFICATION METHODS

Recursive least square method - Recursive instrumental variable methods - Recursive prediction error methods - Recursive pseudolinear regression - Identification of systems operating in closed loop: Identifiability considerations - direct identification - indirect identification.

UNIT IV **8 Hours**

ADAPTIVE CONTROL SCHEMES

Introduction - Types of adaptive control - Gain scheduling controller - Model reference adaptive control schemes - Self tuning regulator - Direct Self tuning regulator - Indirect Self tuning regulator.

UNIT V **8 Hours**

ISSUES IN ADAPTIVE CONTROL AND APPLICATION

Controller Implementation - Estimator Implementation - Interaction of Estimator and control - Operational Issues -Robustness - Introduction, methods for improving robustness - Industrial Adaptive Controller - Application of adaptive control - ship steering.

FOR FURTHER READING

Data and Model Objects in System Identification Toolbox - Two Tank System modeling using SISO Nonlinear ARX and Hammerstein-Wiener Models - Motorized Camera using MIMO Nonlinear ARX and Hammerstein - Wiener Models - Vehicle Dynamics System.

Total: 45 Hours

Reference(s)

1. Karel J. Keesman, System Identification an Introduction, Springer, 2013.
2. Tao Liu, FurongGao, Industrial Process Identification and control design, Step-test and relay-experiment-based methods, Springer- Verilog London Ltd, 2012.
3. K.J. Astrom and B. J. Wittenmark, Adaptive Control, Second Edition, Pearson Education Inc., 2012.
4. LennartLjung, System Identification: Theory for the User, Second Edition, Prentice Hall, 2010.
5. T. Soderstorm and PetreStoica, System Identification, Prentice Hall International (UK) Ltd., 2010.
6. LennartLjung, System Identification: Theory for the User, Second Edition, Prentice Hall, 2008.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					6					2				4				4						20
2	2					2					6			6				4							20
3	2					4				4					6				4						20
4	4					6				4				6											20
5	4					4				6				6											20
																								Total	100

Assessment Questions

Remember

1. Define model of a system.
2. What is model validation?
3. List the properties of identifiability.
4. Name some models which have nonlinearities.
5. Define black box models.
6. List two parametric estimation methods.
7. Define pseudo linear regression.
8. State MIT rule.
9. Define adaptive control technique.
10. Define Self-Tuning Control (STC).

Understand

1. Explain the procedure involved in the system identification process with a neat flow diagram
2. Identify the advantages of state space method.
3. Infer the problems with time invariant systems.
4. Summarize the various frequency domain methods available for non-parametric estimation.
5. Discuss instrumental variable method and compare it with Least square method.
6. Explain the pseudo- linear regression vector for equation error type model structure with the help of one step ahead prediction.
7. Explain the Model Reference Adaptive Control (MRAC) approach and the MIT Rule in deriving a suitable control law.
8. Explain Recursive Least Square (RLS) Technique and the purpose of using this RLS technique in an estimation problem.

9. Represent diagrammatically a nonlinear system.
10. Identify the properties of identifiability.

Apply

1. Execute the properties of identifiability of a model structure.
2. Implement the nonlinear black box model for a nonlinear system and explain its basic features of functions expansions.
3. Find the control law for the following control problem: Consider the transfer function of a linear system kG(s), where G(s) is known and k is an unknown parameter. Find a feedforward controller that gives a system with the transfer function $Gm(s) = k0G(s)$, where $k0$ is a given constant. Use the controller structure $u = \theta uc$, where u is the control signal and uc the command signal.
4. Execute an expression for parameter estimation by least square method.
5. Use the transient response analysis to estimate the system model.
6. Show the properties of least square method.
7. Predict the weakness of impulse response analysis.
8. Assess the frame work for parameter estimation using maximum likelihood method.
9. Demonstrate the usefulness of transient response analysis in system estimation.
10. Use MIT rule to design an MRAS for a first order system and draw the block diagram of the system.

Analyse

1. Differentiate linear regression and regression vector.
2. Consider a linear process with the transfer function kG(s), where G(s) is known and k is an unknown parameter. Find a feedforward controller that gives a system with the transfer function $Gm(s) = k0G(s)$, where $k0$ is a given constant. Use the controller structure $u = \theta uc$, where u is the control signal and uc the command signal. Use the MIT rule to update the parameter q, and draw a block diagram of the resulting adaptive system.
3. Consider the FIR model
   $y(t) = b0u(t) + b1u(t - 1) + e(t)$ *where*, $t = 1, 2, ...$
   Where $\{e(t)\}$ is a sequence of independent normal random variables with zero mean and standard deviation σ. Determine the regressor vector and parameter vector of the linear regression model.
4. Describe the procedure for development of the nonlinear state space model for a system.
5. Differentiate direct Identification andÂ Indirect Identification .
6. Compare Classical feedback system with adaptive system.
7. Compare direct and indirect adaptive methods.
8. Compare Classical feedback system with adaptive system.
9. Compare linear regression and regression vector.
10. Identify the various frequency domain methods available for non-parametric estimation.

Create

1. Design a temperature controller for a chemical reactor using NOVATUNE,a general purpose adaptive controller.
2. Derive an expression for linear model and set of linear models.
3. Obtain an expression for statespace models of time invariant systems.
4. Derive an expression for nonlinear black box model and explain its basic features of function expansions.

15EI004 ADVANCED PROCESS CONTROL 3 0 0 3

Course Objectives

- To analyze the enhanced control strategies and enhancements in PID controllers
- To understand the concept of computing the future output of a plant based on modelling and proposed control action
- To interpret about multi-loop, multivariable, batch control and plantwide control schemes
- To analyze the steps involves in inferential control and process monitoring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Analyze the various advanced control schemes
2. Investigate the need for multi-loop and multivariable control systems
3. Identify the role of batch control and plant wide control
4. Interpret the inferential control and process monitoring schemes
5. Implement Servo and Regulatory operations for different control schemes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2			1					1	2
2	1	2	1	2	2			1					1	2
3	2	2	1	1	2			1					1	2
4	2	3	2	2	3			1					2	2
5	3	2	2	2	2			1					2	2

UNIT I **8 Hours**

INTRODUCTION

Brief review of dynamic behavior of processes, single-loop feedback control systems, stability analysis and design of feedback control systems - Enhanced single loop control strategies - selective control/override systems, nonlinear control systems, adaptive control systems - PID enhancements: anti-reset windup, auto-tuning, gain scheduling and self tuning.

UNIT II **10 Hours**

MODEL BASED CONTROL SYSTEMS

Introduction - Static and Dynamic control law-state - IMC Structure - IMC design procedure - IMC based PID control design - first order and second order process - Model Predictive Control - Optimization problem - Dynamic Matrix Control - Implementation of MPC - case study: distillation column control.

UNIT III **10 Hours**

MULTI-LOOP AND MULTIVARIABLE CONTROL SYSTEMS

Process interaction and control loop interaction, pairing of controlled and manipulated variables - selection of manipulated variables and controlled variables - tuning of multi-loop PID control systems - decoupling and multivariable control strategies - strategy for reducing control loop interaction - Case study: control of mixing tank using multivariable control concept.

UNIT IV **9 Hours**

BATCH CONTROL AND PLANT WIDE CONTROL

Batch control systems: control during the batch - run-to-run control - batch scheduling and hierarchy. Plant wide control issues - steady state and dynamic effects of recycle - control and optimization hierarchy - plant wide control examples: MPN and HDA process - interaction of plant design and control system design. Case study: HDA process (Toluene hydrodealkylation process)

UNIT V **8 Hours**

INFERENTIAL CONTROL AND PROCESS MONITORING

Introduction - Design Criteria - Implementation Issues - Case Study: Fired Heater, Traditional Monitoring Techniques - Quality control charts - Normal Distribution - Control Chart - EWMA Control Chart.

FOR FURTHER READING

Control of Chemical Reactors - Stirred tank and tubular reactor

Total: 45 Hours

Reference(s)

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process Dynamics and Control, John Wiley &sons, 2011
2. Peter Harriott, Process Control, Tata McGraw-Hill, 2011
3. B. Wayne Bequette, Process Control: modelling, Design, and simulation, PHI learning Pvt. Ltd., New Delhi, 2008
4. E. F. Camacho, C. Bordons, Eduardo F. Camacho,Model Predictive Control in the Process Industry, Springer, 2011
5. Thomas E. Marlin, Marlin Thomas, Process Control: Designing Processes And Control Systems for Dynamic Performance, McGraw Hill Publication, 2000
6. Ray Ogunnaike, Babatunde A. Ogunnaike, W. Harmon Ray, Process Dynamics, Modeling, And Control, Oxford University Press, 1997

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2				6				4				6							20
2	4						6			2				4					4						20
3	2				4						4				4				6						20
4	4					6				4					6										20
5	4					4				6					6										20
																								Total	100

Assessment Questions

Remember

1. Recall the functions of selective control.
2. Define feedback control.
3. List out three conditions for stability of feedback control systems.
4. Recognise the cause for anti-reset windup
5. List out the four advantages of MPC.
6. State the various operating levels of batch control system.
7. State the stability theorem related to multi-loop control system.
8. Define linear regression
9. List the parameters to be specified in order to design an MPC system.
10. List the difficulties in controlling a MIMO system.

Understand

1. Interpret the effects when inputs are coupled to the outputs with negative relative gains.
2. Illustrate the effects of dead time in a process. How to overcome this?
3. Summarize the effects of process interaction and loop interaction.
4. Interrelate function between linear regression and least square methods.
5. Interpret the design of digital controller for a given process
6. Explain the objective(s) of model based predictive control.
7. Summarize the benefits of decoupling control scheme.
8. Indicate the steps to identify the subsets of MVs and CVs of a multi-loop system.
9. Indicate the significance of eigen values and eigen vectors.
10. Interpret how to incorporate the safety in plant and control system design.

Apply

1. Compute the dynamic response of a first order lag system with time constant τp =0.5 and static gain Kp =1 to (a)a unit impulse input change,(b)a unit step change a sinusoidal input change of sin0.5t. Examine the behavior of the output after long time (t $\rightarrow$ infinity) for each of the input changes above.
2. Consider a first order system with τp = 30 sec and Kp =1. Initially, the system is at steady state. Then the input changes is given linearly with time: m(t)=t. Compute an expression that shows how the output changes with respect to time for the given input.
3. Predict the interaction among the loops of a distillation column.
4. Show whether given system is stable. Sampled data control systems represented by the following characteristic equation using Jury‘s stability test 6Z^2-2Z+1=0
5. Demonstrate plantwide control with a suitable sketch.
6. Demonstrate batch control proceess with suitable example.
7. ShowÂ whether second order system is equivalent to two first order systems in series.

8. Show whether given system is stableÂ using Jury‘s stability test Z^2-7Z+9=0
9. Compute continuous time transfer function and Convert the continuous time model into discrete time model (Assume N=1, T=0.4).
10. A 2x2 process has the steady state gain matrix K=[1 K12].Â Calculate determinant, RGA, eigen values and singular values of K. Use K12 = 0 as the base case; then recalculate the matrix properties for a small change, K12 = 0.1sec

Analyse

1. Judge whether transfer function be derived for a nonlinear system.
2. Consider the level control system implemented with a computer whose inputs and outputs are calibrated in terms of full range (100%). The tank is 1 m in diameter and the valve on the exit line act as a linear resistance with R= 6.37min/m2 . The level transmitter has a span of 0.5 m and an output range of 0 to 100%. The flow characteristic of the equal percentage control valve is related to the fraction of lift l by the relation f = 1 (30)l-1. The air-to-open valve receives a 3 to 15 psi signal from an I/P converter, which in turn, receives a 0 to 100% signal from the computer implemented proportional controller. When the control valve is fully open (l =1), the flow rate through the valve is 0.2 m3 /min. At the nominal operating condition, the control valve is half open (l =0.5). Determine the closed-loop response to a unit step change in the set point for three values of the controller gain: Kc=1, 2 and 5.
3. Flow control loops are usually fast compared to other loops, and so they can be considered to be at steady state (essentially). In this case, Integral control is recommended. Judge whether for Gd= Gp=Kp, the integral control provides satisfactory control for both set point change and disturbance.
4. Why do we claim that there are a large number of control configurations for a MIMO process? Determine the number of alternative control loop configuration for a process with N controlled variables and M manipulations, where M>N.
5. Consider a process that consists of a liquid chemical tank with two level indicators, a heater, inlet pump, outlet pump and two valves. Assume that we want to perform the following sequence of operations: a) Start the sequence by pressing a button S. b) Fill the tank with a liquid by opening valve V1 and turning ON the pump P1 until the upper level L1 is reached. c) Heat the liquid until the temperature is greater than TH. The heating can start as soon as the liquid level above the lower limits L0. d) Empty the liquid by opening valve V2 and turning ON pump P2 until the lower level L0 is reached. e) Close the valves and go to step (a) and wait for a new sequence to start. Determine information flow diagram, sequence function chart and ladder diagram for above sequence process.
6. Justify the need for parameter estimation in a process control.
7. Differentiate between linear regression and least square methods
8. Outline the effects when inputs are coupled to the outputs with negative relative gains
9. Structure a flowchart for performing stability analysis of a non-linear process model.

Evaluate

1. Judge whether transfer function be derived for a nonlinear system

Create

1. Derive the expression for Relative Gain Array.
2. Relate the controlled variable and the manipulated variable in a multi-loop control scheme

15EI005 POWER PLANT INSTRUMENTATION 3 0 0 3

Course Objectives

- To gain knowledge on different methods of power generation
- To provide clear view of the various measurements involved in power generation plants
- To understand about the Piping and Instrumentation (P&I) diagram

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. To recall different types of power generation methods and to explain the basic power building blocks of thermal power plant
2. To summarize the measurement process of electrical and non electrical parameters used in thermal power plant
3. To analyze various control schemes used for the control of combustion of air, fuel, flue gas dew point and soot blowing.
4. To implement control scheme for boiler control parameters like burner and furnace control, pulveriser and combustion control.
5. To organize the methods used for turbine safety and control

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1									2	
2	1	2	3										3	
3	1	3	2	1									3	
4	1	3	2	1									2	
5	1	1	2	3									2	

UNIT I **9 Hours**

OVERVIEW OF POWER GENERATION

Survey of methods of power generation - hydro, thermal, nuclear, solar and wind power - importance of instrumentation in power generation - thermal power plant - building blocks - combined cycle system - combined heat and power system - sub critical and supercritical boilers-details of boiler processes P&I diagram of boiler - cogeneration.

UNIT II **9 Hours**

MEASUREMENTS IN POWER PLANTS

Electrical measurements - current, voltage, power, frequency, power factor etc.- non electrical parameters -Measurement of feed water flow, air flow, steam flow and coal flow - drum level measurement - steam pressure and temperature measurement - turbine speed and vibration measurement - flue gas analyzer - fuel composition analyzer- smoke density measurement -dust monitor.

UNIT III **9 Hours**

BOILER CONTROL I

Combustion of fuel and excess air- firing rate demand - steam temperature control - control of deaerator - drum level control - single, two and three element control - furnace draft control - implosion - flue gas dew point control -trimming of combustion air - soot blowing.

UNIT IV **9 Hours**

BOILER CONTROL II

Burners for liquid and solid fuels - burner management - furnace safety interlocks - coal pulverizer control - combustion control for liquid and solid fuel fired boilers - air/fuel ratio control - fluidized bed boiler - cyclone furnace.

UNIT V **9 Hours**

CONTROL OF TURBINE

Types of steam turbines - governing system - speed and load control- transient speed rise -free governor mode operation - automatic load frequency control - turbine oil system - oil pressure drop relay - oil cooling system - turbine run up system - Case study.

FOR FURTHER READING

Application:Tidal power plant - Geo-thermal power generation - Solar Power Satellite - Recent trends in thermal power plant.

Total: 45 Hours

Reference(s)

1. Swapan Basu and Ajay Kumar, Power Plant Instrumentation and Control,Elsevier,2015
2. Krishnaswamy.K and Ponnibala.M., Power Plant Instrumentation, PHI Learning Pvt.Ltd., New Delhi, 2011
3. Jain R.K., Mechanical and Industrial Measurements,Khanna Publishers, New Delhi, 2013
4. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2013
5. Jain R.K., Mechanical and Industrial Measurements,Khanna Publishers, New Delhi, 2013

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	3			1	4	2			4	1			1			2								20
2	2	3			2	4	2			6				1											20
3	2	1			4	6	2			1				3			1								20
4	1	3			2	7	1			2				2											18
5	3	2			2	2	1		2	6				2			2								22
																								Total	100

Assessment Questions

Remember

1. Define cogeneration
2. List out the advantages of hydro power plant
3. List out the advantages of thermal power plant
4. Name the various method of power generation
5. What is meant by pulversing of coal?
6. Draw the block diagram of thermal power plant.
7. State Chain reactions
8. Define fission process
9. Recall the types of boilers
10. Define piping and instrumentation diagram.
11. List the types of Radiation detector
12. List the different types of level sensing device
13. Define turbine
14. Define electrical precipitators
15. List the types of pre-heating methods.
16. List out the parameter to be measured in deaerator control
17. Define vibration displacement

Understand

1. Identify the purpose of the reservoir?
2. Represent the pressure transmitting line using P&I diagram
3. Identify the reason why float type level measurement is not suitable for boiler drum level measurement?
4. Elucidate the essential of vibration measurement in turbine control.
5. Identify the requirements of sustain fission process
6. Elucidate the properties of a good moderator
7. Explain the purpose of control rods
8. Explain how to determine the actual speed in a stroboscope?
9. Illustrate the purpose of mechanical type vibration instruments
10. Explain about the need of long retractable soot blowers
11. Indicate where we use the electrical precipitators?
12. Exemplify how the pollution from power plant is reduced
13. Illustrate the purpose of cooling system used in a power plant
14. Classify Solar and Wind Power generation schemes
15. Compare steam turbine and gas turbine
16. Indicate the device used for current and voltage measurement in power plant.
17. Identify the different parameters for failure analysis in power plant

Apply

1. Find a 60MW turbo generator set has an overall efficiency of 25%. The calorific value of a coal used is 24 MJ/Kg. Calculate the consumption of coal per kWh and also per day if the load factor is 30%
2. A stage of an impulse turbine operates close to the maximum blading efficiency. The blades are equiangular; the friction effects in blades may be neglected. The mean blade velocity is 200 m/s and the steam flow rate is 0.75kg/s. Compute the discharge angle at which the steam leaves the blade and the diagram power
3. Find a nuclear power plant is operated continually for one year producing 500MW. The reactor contained 75 tonnes of 3% enriched uranium dioxide fuel. Assuming the power plant efficiency to be 33% calculate the mass of U-235 consumed in kg.

4. Find a condenser for a steam power plant receivers 185 t/h of steam 40 deg Celsius, 92% quality. cooling water enters 33 deg Celsius and leaves 37 deg Celsius. The condensate leaves at 39 deg Celsius. The pressure inside the condenser is found to be 0.077 bar. Calculate the cooling water flow required in m3/s.
5. Demonstrate a P&I diagram for basic neutralizer control
6. Demonstrate a P&I diagram for Distillation Column
7. Demonstrate a P&I diagram for basic column control
8. Demonstrate the piping and instrumentation diagram for automatic rice cooking machine
9. Demonstrate the piping and instrumentation diagram for fresh milk vending machine
10. Demonstrate piping and instrumentation diagram for batch reactor control system

Analyse

1. Differentiate the function of thermal, nuclear and hydro power plant
2. Compare the different types of boilers.
3. Differentiate between steam turbine and gas turbine
4. Compare two element and three element drum level control.
5. Differentiate tidal and geo thermal power plant
6. Differentiate solar and tidal power plant
7. Differentiate flue gas analyzer and fuel composition analyzer
8. Compare current, voltage, power, frequency, power factor with its equation
9. Compare measurement of feed water flow, air flow, steam flow and coal flow
10. Compare sub critical and supercritical boilers

Create

1. Derive a steam power plant, operating with one regenerative feed water heating is run at the initial steam conditions of 35.0 bar and 440°C with exhaust pressure of 0.040 bar. Steam is bled from the turbine for feed water heating at a pressure of 1.226 bar. Generate (1) Specific heat consumption (2) Thermal efficiency of the cycle (3) Economy percentage compared with the cycle of a simple condensing power plant
2. Generate a piping and instrumentation diagram for thermal power plant

15EI006 INDUSTRIAL ROBOTICS 3 0 0 3

Course Objectives

- To understand the basic concepts associated with the design, functioning and applications of robots.
- To differentiate the robotic sensors, actuators and end-effectors.
- To formulate the control algorithms and path planning algorithms for the robots.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Identify the evolution of robotics
2. Interpret the basic concepts associated with the design, functioning and applications of robots.
3. Apply the kinematics ofa robotic manipulator.
4. Design the control algorithms and path planning algorithms for the robots.
5. Select the suitable sensor, actuator and gripper for the robot.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2	1										2
2	3		2	1										2
3	3		2	2										2
4	3		2	3										2
5	3		2	1										2

UNIT I **8 Hours**

FUNDAMENTALS OF ROBOTICS

Automation and robots - a brief history of robotics - definition and laws of robotics - anatomy of robot - robot classifications - robot specifications - robot configurations - robot links - robot joints - performance parameter - applications of robots.

UNIT II **11 Hours**

ROBOT KINEMATICS

Robot architecture - pose of a rigid body - coordinate transformation - homogenous coordinates - Denavit and Hartenborg (DH) parameters - forward position analysis - inverse position analysis - velocity analysis: The Jacobian matrix, link velocities, singularity - acceleration analysis.

UNIT III **8 Hours**

ROBOT POWER SOURCES AND END EFFECTOR

Power Sources: Hydraulic, pneumatic and electric drives - Determination of HP of motor and gearing ratio. End Effector: Types of end effector - mechanical grippers - vacuum cups - magnetic grippers - adhesive grippers - hooks, scoops, miscellaneous devices - tools as end effector - the robot end effector interface - selection and design of the gripper.

UNIT IV **8 Hours**

ROBOTIC SENSORS AND VISION

Sensors in robotics - classification - tactile, proximity and range sensors - sensors based systems; Introduction to machine vision - the sensing and digitizing function in machine vision - image processing and analysis - training the vision system - robot programming and languages.

UNIT V **10 Hours**

PATH PLANNING, CONTROL OF ROBOTIC MANIPULATORS AND APPLICATIONS

Considerations on trajectory planning - joint interrelated trajectories - cartesian path trajectories - control of robot - PID control - computed torque technique - Robots in manufacturing and non-manufacturing application - Robot cell design - selection of a robot.

FOR FURTHER READING

Rail Guided Vehicles (RGV), Automated Guided Vehicles (AGV) - implementation of robots in industries - various steps - safety considerations for robot operations - Economic Analysis of Robots - Pay back Method, Equivalent Uniform Annual Cost (EUAC) Method, Rate of Return Method.

Total: 45 Hours

Reference(s)

1. Robert J. Schilling, Fundamentals of Robotics: Analysis & Control, Prentice Hall of India Private Limited, New Delhi, 2010.
2. Mikell P.Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G. Odrey, Industrial Robotics, Tata McGraw-Hill Education, 2012.
3. S K Saha, Introduction to Robotics, Tata McGraw-Hill Education, 2013.
4. K S Fu,Ralph Gonzalez,C S G Lee, Robotics: Control, Sensing, Vision, and Intelligence, Tata McGraw-Hill Education, 2010.
5. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering - An integrated approach, Prentice Hall of India, New Delhi, 2012.
6. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, Springer-Verlog Berlin Heidelberg, 2008.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			4	12																			20
2		2				2				4													12		20
3	4	2			2	12																			20
4	2	2			4	12																			20
5	2	2				2				2				12											20
																								Total	100

Assessment Questions

Remember

1. Define degrees of freedom in robotic manipulator.
2. Classify the robots.
3. List the programming languages used in robots.
4. List the specifications of robot.
5. List the different internal and external sensors that can be used in designing a robot arm.
6. List the any four tools used as end effectors in robot applications.
7. State the significance of integral gain.
8. List the technical features required for machine loading applications.
9. Define structural length index in workspace of a robot.
10. List the advantages of pneumatic actuator.

Understand

1. Illustrate the robot language structure.
2. Explain the origin and various generations of robots.
3. Explain the control issues in robotic manipulator.
4. Illustrate the in-line robot work cell.

5. Illustrate the hydraulic actuator components.
6. Explain the functions of machine vision techniques used in robotics.
7. Identify the considerations in gripper selection and design based on Engelberger's factors.
8. Compare the PD and PID controller for the joint in robotic arm.
9. Explain the pick and place robot operation in material transfer applications.
10. Illustrate the any two applications of robots in non -manufacturing applications.
11. Classify the non-industrial applications of robotics.

Apply

1. A vector P=3i-2j+5k is first rotated by 90 degree about x-axis, then by 90 degree about z-axis. Finally, it is translated by -3i+2j-5k.Compute the new position of vector P.
2. Compute the DH parameters for the three revolute (3R) planner arm.
3. Compute inverse kinematics solution for a three link planner arm.
4. Compute the inverse kinematics solution for three link planner arm based on the given data. The input homogenous matrix, T=[0.25 -0.866 0 4.232; 0.866 0.5 0 1.866; 0 0 1 0;0 0 0 1]. Link lengths: a1=a2= 2 units and a3= 1 unit.
5. A pert weighing 8 kg is to be held by a gripper using friction against two opposing fingers. The coefficient of friction between the fingers and the part is estimated to be 0.3. The orientation of the gripper will be such that the weight of the part will be applied in a direction parallel to the contacting finger surfaces. A fast work cycle is anticipated so that the g factor to be used in force calculations should be 3. Compute the required gripper force for the given specifications.
6. A motor has a torque constant, Km=10 oz-in./A and a constant voltage of 12 V/Kr/min. The armature resistance is 2 ohm. If 24 V were applied to the terminals compute the torque at stall (0 r/min).
7. A vacuum cup gripper is used to lift steel plates weighing 100.48 lbs. Each of the two vacuum cups is 10Â inches in diameter. Assuming a safety factor of 2.6, compute the negative pressure required to lift a steel plate.
8. A stepper motor is used to drive a linear axis of a robot. The motor is connected to a screwed shaft having a single start thread of pitch 2.5 mm. The resolution desired for the controlled motion is 0.5 mm. Compute: i) Step angles that are required on the motor to obtain the resolution. ii) Pulse rate required to drive the axis if the velocity is 80 mm/s.
9. Compute the translated vector for the given vector v = 25i + 10j + 20k, perform a translation by a distance of 8 units in **x**direction, 5 units in **y** direction and 0 units in **z** direction.
10. Compute the time required for each joint of a three axis RRR manipulator to travel the following distance using slew motion: Joint 1, 30 degree, Joint 2, 60 degree; and Joint 3, 90 degree. All joints travel at a rotational velocity of 30 degree/s. neglect the effects of acceleration and deceleration.

Analyse

1. Outline the functions involves the interfacing of the end effector with the robot.
2. Differentiate touch and force sensors.
3. Outline theÂ gripper mechanisms used in mechanical gripper.
4. The weight of a robot = 100 lbs. The angle of incline is 6o. The robot builds up its peak speed of 20 MPH over a distance of 100 feet. Compare the HP of the required motor by two different methods. Assume g = 32.2 ft/(sec*sec).

Evaluate

1. Determine the rotation matrix for the ZYZ Euler angles.
2. Determine the degrees of freedom for SCARA configuration in spatial domain.
3. Suppose the reference frame M coincides with the fixed frame F. Now, the frame M is rotated by an angle **α** about the axis Z. Determine the rotation matrix for M with reference to F.

4. If the two links of a two-link planner manipulator have equal lengths, Determine expression for the homogenous transformation matrix.
5. A DC servomotor used to actuate a robot joint has a torque constant of 25 in.-lb/A, and a constant voltage of 15 V/Kr/min. The armature resistance = 3.0 ohms. At a particular moment during the robot cycle, the joint is not moving and a voltage of 30 V is applied to the motor. Determine the torque of the motor immediately after the voltage is applied.
6. A vacuum cup gripper is used to lift steel plates weighing 60.48 lbs. Each of the two vacuum cups is 5 inches in diameter. Assuming a safety factor of 1.6, determine the negative pressure required to lift a steel plate.

Create

1. Derive the resultant forward kinematics equation for the 4-DOF SCARA robot.
2. Derive the resultant forward kinematics equation for the PUMA 560 robot.

15EI007 SOFT COMPUTING TECHNIQUES 3 0 0 3

Course Objectives

- To understand the learning algorithm used in different artificial neural network
- To analyze the functions of fuzzy relations and fuzzy inference systems
- To apply neural networks and fuzzy systems to model and solve practical problems
- To understand the steps involved in genetic algorithm and solve simple optimization problems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Analyse the fundamental concept of neural networks and neuro-modelling
2. Apply the concept of artificial neural network in control applications
3. Determine the concept of fuzzy sets, knowledge representation using fuzzy rules and fuzzy inference systems.Design fuzzy-logic based controllers and explore their unique characteristics
4. Apply neural networks and fuzzy controller in real time application.
5. Analyze the steps involved in genetic algorithm implementation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	1						1			1
2	2	2	1	2	1						1			1
3	2	2	1	1	1						1			2
4	2	3	1	2	2						1			2
5	2	3	2	3	2						1			1

UNIT I **9 Hours**

ARTIFICIAL NEURAL NETWORK

Biological neuron and their artificial models - neuron modeling - learning rules - McCulloch-Pitts Neuron - Hebb network - types of neural networks - single layer feed forward network - Perceptron - multi layer feed forward network - back propagation - learning factors.

UNIT II **8 Hours**

NEURAL NETWORKS IN CONTROL APPLICATIONS

Feedback networks - Autoassociative and Heteroassociative memory network - Hopfield networks - applications of neural networks - process identification - artificial neuro controller for inverted pendulum.

UNIT III **10 Hours**

FUZZY LOGIC SYSTEMS

Classical sets - fuzzy sets - fuzzy operation - fuzzy relations - fuzzification - defuzzification - if-then rules- Membership function - knowledge base - data base - rule base - decision-making logic - Fuzzy Inference System(FIS): Mamdani, Sugeno and Takagi architecture.

UNIT IV **8 Hours**

FUZZY LOGIC APPLICATIONS

Fuzzy controller for inverted pendulum, image processing, blood pressure during anesthesia - introduction to neuro-fuzzy controllers.

UNIT V **10 Hours**

GENETIC ALGORITHM

Introduction- Basic operators - General Genetic algorithm - Classification: Adaptive, Hybrid, Parallel-Optimization of travelling salesman problem using Genetic algorithm approach.

FOR FURTHER READING

MATLAB Toolbox - Neural Networks, Fuzzy Logic, Genetic Algorithm - Design of fuzzy PID controller

Total: 45 Hours

Reference(s)

1. Sivanandam S N, Deepa S N, Principles of Soft Computing, Second Edition, Wiley India (P) Ltd.,2011
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, John Wiley & Sons Ltd,2011
3. Sivanandam S N, Deepa S N, Introduction to Genetic Algorithms,Springer, 2010

4. Jacek M.Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, New Delhi, 2014
5. B. Yagnanarayanan, Artificial Neural Networks, Prentice Hall of India Ltd .,New Delhi,2012
6. G.J. Klir and T.A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India Ltd., New Delhi,2009

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					6					6			4					2						20
2		2				4				8					4			2							20
3	4					6					10			4					4						28
4	2					4				2				4											12
5	4					6				10															20
																								Total	100

Assessment Questions

Remember

1. List the three basic elements of a neuron model.
2. Define defuzzification.
3. Name any four methods of defuzzification.
4. List any two advantages of the Back propagation algorithm.
5. List any three applications of the fuzzy logic controllers in real time world.
6. Recall any four properties of fuzzy sets
7. List any four types of learning rules.
8. State the output of Â AND function and OR function neuron.
9. Define Hebbian learning rule.
10. State Linguistic variable.

Understand

1. Explain the simplified model of an artificial neuron.
2. Illustrate the training and classification of continuous perception with an example.
3. Explain back propagation algorithm with your own training sets.
4. Interpret the parts and functions of biological neuron.
5. Exemplify the perceptron multilayer network with its algorithm
6. Indicate the steps in designing a fuzzy control system
7. Summarize the defuzzification methods with appropriate mathematical representations.
8. Explain the operation of the fuzzy logic control with the process inference block.
9. Explain the resemblance of Artificial Neural Network with human brain.
10. Explain the algorithm of discrete feedback network containing only one layer of neurons with a neat sketch

Apply

1. Implement the fuzzy rule for home heating system
2. Implement fuzzy logic controller for blood pressure control during anesthesia.
3. Assess various techniques involved in pattern recognition.
4. Construct a discrete Hopfield network with input vector [1 1 1 -1]. Test the network with missing entries in first and second components of the stored vector.

5. Implement a suitable artificial neuro controller to stabilize the inverted pendulum components of the stored vector.
6. Compute the net input to output neuron with [x1,x2,x3] = [0.3,0.5,0.6] and [w1,w2,w3] = [0.2,0.1,-0.3]
7. Implement OR function with binary inputs and bipolar targets using perceptron training algorithm upto 3 epochs. ,0.1,-0.3]
8. Compute the power set and cardinality of power set of given set X={3,5,7,9}. --EndFragment--> ,0.1,-0.3]
9. Implement ANDÂ function with binary inputs and bipolar targets using perceptron training algorithm upto 2 epochs.
10. Implement the inverse plant identification process and its characteristics using appropriate neural network.

Analyse

1. Differentiate supervised and unsupervised learning.
2. Differentiate feed-forward and feed-back neural network.
3. Compare Fuzzy sets and Crisp sets.
4. Analyze the goal of inverted pendulum.
5. Outline the necessity of fuzzy databases and explain.
6. Compare single layer perceptron classifier and multi-layer perceptron classifier.
7. Differentiate auto-associative and hetero-associative memory neural networks.
8. Compare fuzzy set and classical set.
9. Justify the need for training the neural network.
10. Justify whether laws of excluded middle and contradiction are applicable for fuzzy set.

Create

1. Assume that the vertices of a three-dimensional bipolar binary cube are used to represent eight states of recurrent neural network with three bipolar binary neurons.The equilibrium states are p = [- 1 - 1 - 1] and q = [1 1 1]. Sketch the desirable state transitions between the vertices.
2. Design a Hopfield network for 4 bit bipolar patterns. The patterns are 1st sample S1 = [1 1 -1 -1], 2nd sample S2 = [-1 1 -1 1], 3rd sample S3 = [-1 -1 -1 1]. Find the weight matrix and the energy for the three input samples. Determine the pattern to which sample S = [-1 1 -1 -1] associates.

15EI008 EMBEDDED SYSTEM 3 0 0 3

Course Objectives

- To study the various components within an embedded system and their interactions
- To study the techniques of interfacing between processors & peripheral devices
- To enable writing of efficient programs for a given process
- To understand the software tools available in an embedded system

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Outline the fundamental concept of embedded systems.
2. Identify the appropriate processor for an application and its memory organisation techniques.
3. Compare and Contrast serial communication devices and parallel communication devices.
4. Analyze the concepts of different device drivers and interrupt servicing mechanism.
5. Develop an embedded system application using 8051 microcontroller.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3										1	
2	3	2	3	2	1								2	
3	2	1	2											
4	2	3	2	1	1									
5	3	3	3	2	3	1								2

UNIT I **9 Hours**

INTRODUCTION TO EMBEDDED SYSTEMS

Embedded System - Processor in the System - Hardware Units - Software Embedded into a System - Exemplary Embedded Systems - Embedded System-On-Chip (SOC) and in VLSI Circuit.

UNIT II **9 Hours**

PROCESSOR AND MEMORY ORGANIZATION

Structural Units in a Processor - Selection for an Embedded System - Memory Devices - Memory Selection for an Embedded System - Allocation of Memory to Program Segments and Blocks - Memory Map of a System - Direct Memory Access - Interfacing Processor - Memories and I/O Devices.

UNIT III **9 Hours**

DEVICES AND BUSES FOR DEVICE NETWORK

I/O Devices - Timer and Counting Devices - Serial Communication Using the I2C, CAN - Advanced I/O Buses between the Networked Multiple Devices - Host System or Computer Parallel Communication between the Networked I/O - Multiple Devices using the ISA, PCI, PCI-X and Advanced Buses

UNIT IV **9 Hours**

DEVICE DRIVERS AND INTERRUPTS SERVICING MECHANISM

Device Drivers - Parallel Port Device Drivers in a System - Serial Port Device Drivers in a System - Device Drivers for Internal Programmable Timing Devices - Context and the Periods for Context - Switching - Deadline and Interrupt Latency.

UNIT V **9 Hours**

EMBEDDED SYSTEM DESIGN USING MICROCONTROLLERS

Intel's series of micro-controllers - Design case study using 8051, A/D converters and other peripherals devices - Applications (Biometrics, RFID)

FOR FURTHER READING

Basic implementation using IDE - Implementation of hardware Interrupt - Interface 7 Segment Display using I2C - Serial communication using UART - Interface LM35 temperature sensor using ADC - Implementation of device drivers: USB

Total: 45 Hours

Reference(s)

1. John B Peatman, Design with PIC Micro controllers, Prentice Hall of India book Co, New Delhi, 2012.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ,PIC Microcontroller and Embedded Systems using Assembly and C for PIC18, Pearson Education, 2012.
3. Rajkamal, Embedded Systems Architecture, Programming and Design, Tata McGraw Hill book Co, New Delhi, 2008.
4. Jonathan W. Valvano, Embedded Microcomputer Systems, Real Time Interfacing, Brooks cole, 2004.
5. David E Simon, An Embedded Software Primer, Addison Wesley Publishing Co, New Delhi, 2003.
6. Jonathan W. Valvano, Embedded Microcomputer Systems, Real Time Interfacing, Brooks cole, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2				6				6				2	6								2			24
2	2					6			2	6			2									2			20
3		2			2	2				6				6									2		20
4		2					8		2	2			2									2			18
5		2			2	2	2		6				2									2			18
																								Total	100

Assessment Questions

Remember

1. Define an embedded system
2. Define ROM image.
3. Define bus.
4. List any two purposes of program counter.
5. Define SOC.

6. List 2 importance of DMA.
7. Define plug and play devices.
8. Define context, interrupt latency and interrupt service deadline.
9. Define resolution and conversion time in ADC.
10. Classify the instruction set of 8051.
11. List four control and I/O instructions used in 8051.
12. List four control and I/O instructions used in 8051.

Understand

1. Identify the components of embedded system hardware.
2. Identify the classification of embedded systems.
3. Indicate two conditions that should be considered in selecting a processor for an embedded system?
4. Represent three stage pipeline and superscalar processing.
5. Identify the need of software timers.
6. Represent the interrupt structure of 8051.
7. Summarise the architecture of 8051.
8. Exemplify the basic concepts involved in memory interfacing?
9. Formulate the steps involved in coding the program and test the program?
10. Identify the characteristics that are taken into account when interfacing a device port
11. Identify ten ways by which the synchronous signals with the clocking information transmit from a master device to slave device.
12. Explain the signals, clock-inputs, control bits and status flags at registers or memory in a hardware timer device.

Apply

1. Predict the common characteristics of embedded system
2. Demonstrate the conceptual working of an embedded system.
3. Select an appropriate method for inter task communication
4. Construct a 6-tuple format of the FSM with a neat description.
5. Design an embedded system for an adaptive cruise control system in a car.
6. Demonstrate a scenario with pseudocode where the monitors implement synchronized producer consumer problem
7. Predict a pseudocode for read and write operations of elevator communication constructs using shared memory.
8. Design a 3-bit counter that counts the following sequence: 1, 2, 4, 5, 7, 1, 2, etc. This counter has an output “odd” whose value is 1 when the current count value is odd. Use the sequential design technique of the chapter. Start from a state diagram, draw the state table, minimize the logic, and draw the final circuit.
9. Design a 2-bit comparator (compares two 2-bit words) with a single output “less-than,” using the combinational design technique described in the chapter. Start from a truth table, use K- maps to minimize logic, and draw the final combinational circuit.
10. Demonstrate a scenario with pseudocode where the monitors implement producer consumer problem.

Analyse

1. Differentiate volatile and non-volatile memory.
2. Differentiate serial and parallel ports.
3. Outline the techniques of power and energy management in a system
4. Conclude the role of processor reset and system reset.
5. Justify the use of vector address for an interrupt source

Evaluate

1. Determine the reduction in power dissipation for a processor CMOS circuit when voltage reduces from 5V to 1.8V operation.
2. Check for the steps involved in initializing and configuring a device
3. How do you assign service priority to the multiple device drivers of a system.
4. Criticise on the usage of queues used for a network.
5. Determine the hardware and software parts of an automatic chocolate vending machine

Create

1. Design an embedded system for a smart card and automatic chocolate vending machine.
2. Design microcontroller system to control traffic signals.
3. Design seven segment LED display using 8051

15EI009 CODES AND STANDARDS 3 0 0 3

Course Objectives

- To understand the instrumentation standards govern by different organizations
- To apply safety standards for safety PLC
- To understand standards implemented in industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Understand various types of National Fire Protection Association
2. Analyze different types of ISO standards used in instrumentation
3. Construct Piping and Instrumentation diagram using ISA standards
4. Infer various safety standards and protocols used for the various process in industries
5. Interpret different protocols used for the various process in industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	1		1		2						1
2	2	2	2	2		1		2						1
3	2	2	3	2		1		3					1	1
4	3	2	3	2		1		3					1	2
5	3	3	2	3		1		3					1	2

UNIT I **9 Hours**

STANDARDS

Codes and Standards:National Fire Protection Association (NFPA)-NFPA 70:National Electric Code, NFPA 496:Standard for Purged and Pressurized Enclosures for Electrical Equipment-Instrument Society of America (ISA):Safety Standard for Electrical and Electronic Test (ISA S82.01), Definitions and Information Pertaining to Electrical Instruments (ISA S12.1), Application of Safety Instrumented Systems for the Process Industries(ISA S84.01).

UNIT II **9 Hours**

ISO - THE INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

EIA 232 interface standard - EIA 485 interface standard - EIA 422 interface standard - Serial interface converters - ISO/OSI Reference(s) model- Data link control protocol - Media access protocol: Token passing and CSMA/CD - TCP/IP -Standard ETHERNET Configuration.

UNIT III **9 Hours**

INTERNATIONAL SOCIETY OF AUTOMATION

ISA standards- Process Flow Diagram - P and I diagram: symbols and layout - Loop diagram -Tagging conventions -Line and function symbols - Equipment representation - P&I diagram for basic neutralizer control system -Distillation Column.

UNIT IV **9 Hours**

STANDARDS FOR SAFETY PLC

Characteristics of safety PLCs:Hardware characteristics of safety PLC- Software Characteristics of safety PLC - Design of safety PLCs - Triple Modular Redundant (TMR systems) - Safety PLC with 1003 architecture - Communication feature of safety controllers - New development in communication

UNIT V **9 Hours**

SAFETY STANDARDS

Safety Instrumentation Standards - Electrical Standards -Fire and Gas Standards - Oil and Gas Standards - Sub sea Control Systems Standards - Protective Coating Standards

FOR FURTHER READING

Application of P&I diagrams in paper industry - Cement industry - Sugar cane industry - HART application -Industrial Ethernet application

Total: 45 Hours

Reference(s)

1. National Fire Protection Association,Quincy,Massachusetts,2014
2. G.K.McMillan, Process/Industrial Instrument and Controls Handbook, Fifth Edition, McGraw-Hill handbook, New York, 2011
3. J.Berge, Field Buses for Process Control: Engineering, Operation, and Maintenance, ISA Press, 2010
4. Terrence L. Blevins, Mark Nixon, Control Loop Foundation: Batch and Continuous Processes, ISA, 2011.
5. Dave Macdonald, Practical Industrial Safety, Risk Assessment and Shutdown Systems, Elsevier publication, 2004
6. Steve Mackay, Edwin Wright, John Park, Deon Reynders, Practical Industrial Data Networks, Elsevier, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	5	2			3				5				3				2								20
2	4	4			2	2	1		3	2			1				1								20
3	2		2		3	2	1		3	3				3			1								20
4	2		2		2	1	1		3	3			2	2				2							20
5	3		2		2		3		2	3	1		1	1			1	1							20
																								Total	100

Assessment Questions

Remember

1. Define NFPA?
2. List different types of standards used in ovens and furnace?
3. List different types of standards used in purged and pressurized enclosure
4. List different types of standards used in Compressed Gas for Industrial and Medical Facilities
5. List different types of standards used in Fire Protection
6. State loop diagram
7. List some of the line and function symbols
8. List some of the industrial safety standards
9. Define TMR
10. Recall ISO

Understand

1. Explain about different level of Â ISO standards
2. Interpret P&I diagram for basic neutralizer control system
3. Exemplify P&I diagram for Distillation Column
4. Summarise in detail about Data link control protocol
5. Explain in detail about Media access protocol
6. Explain about TCP/IP
7. Illustrate EIA 485 interface standard with its pin diagram
8. Illustrate EIA 232interface standard with its pin diagram
9. Explain in detail about ETHERNET
10. Explain in detail about Safety Instrumentation Standards for fire and gas Standards

11. Explain in detail about Safety Instrumentation Standards for fire and gas Standards

Apply

1. Draw ladder logic diagram for count the cycle of Extraction and Retraction of a Â cylinder.
   One cycle is 1 Extraction and 1 Retraction.
   Switch off the cylinder power supply when it reach10 Cycles
2. Find where can be PLC used in the place of relays?
3. Show will the power for the output on the first rung normally in ON state or OFF state?
   Would the output on the second rung normally is ON state or OFF state?
4. Find in dangerous processes it is common to use two palm buttons that require a operator to use both hands to start a process (this keeps hands out of presses, etc.). To develop this there are two inputs that must be turned on within 0.25s of each other before a machine cycle may begin.
5. Find a counter goes below the bottom limit which counter bit will turn on?
6. Demonstrate PLC is preferred more than DCS, Defend.
7. Demonstrate the bottle filling system using PLC with ladder logic
8. Show the program for control instructions, math instructions and sequencer instructions used to execute certain functions in PLC and SCADA?
9. Demonstrate the stamping system using PLC.
10. Demonstrate piping and instrumentation diagram for fresh milk vending machine
11. Demonstrate piping and instrumentation diagram for rice cooking machine

Analyse

1. Compare any two real time applications of PLC and DCS in detail
   A conveyor is run by switching ON or OFF a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to Wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active.
2. Differentiate between PLC and SCADA automation software.
3. Justify Ladder logic outputs are coils
4. Differentiate between DCS and PLC
5. Compare timers and counters
6. Compare EIA 485 with EIA 422 interface standard
7. Compare EIA 422 interface standard with EIA 232 interface standard
8. Compare EIA 232 interface standard with EIA 485 interface standard
9. Contrast PLC with DCS

Create

1. Generate a system involving a PLC for the placing on a conveyor belt of boxes in batches of four
2. Generate a simple program that will use one timer to flash a light. The light should be on for 1.0 seconds and off for 0.5 seconds. Do not include start or stop buttons
3. Derive ladder logic that uses a timer and counter to measure a time of 50 days

15EI010 HYDRAULICS AND PNEUMATICS 3 0 0 3

Course Objectives

- To learn hydraulic fluid / Pneumatic air fundamentals including generation and distribution
- To understand working principles, operation of hydraulic and pneumatic components
- To expose to various techniques of circuit building in pneumatics
- To know about the ladder logic diagram to programmable logic control of fluid power system

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Understand the fundamentals of fluid power systems and hydraulic systems.
2. Identify various hydraulic system components and to illustrate the construction and working of various pumps and actuators.
3. Outline the constructional details of control valves and accumulators.
4. Identify the various pneumatic system components and to design a penumo hydraulic circuit for simple applications.
5. Analyze the characteristics of different pneumatic systems used for simple applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											1
2	1	3	2											2
3		1	3	2										3
4		1	3	2										3
5		1	3	2										3

UNIT I **9 Hours**

FLUID POWER SYSTEMS AND FUNDAMENTALS

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids - General types of fluids - Fluid power symbols. Basics of Hydraulics Applications of Pascals Law- Laminar and Turbulent flow - Reynold's number - Darcy's equation - Losses in pipe, valves and fittings.

UNIT II **9 Hours**

HYDRAULIC SYSTEM AND COMPONENTS

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump,
construction and working of pumps - pump performance - Variable displacement pumps. Fluid Power Actuators:Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators - Fluid motors, Gear, Vane and Piston motor

UNIT III **9 Hours**

DESIGN OF HYDRAULIC CIRCUITS

Construction of Control Components: Direction control valve - 3/2 way valve - 4/2 way valve - Shuttle valve - check valve - pressure control valve - pressure reducing valve, sequence valve, Flow control valve - Fixed and adjustable, electrical control solenoid valves, Relays. Accumulators and Intensifiers: Types of accumulators - Accumulators circuits, sizing of accumulators, Intensifier - Applications of Intensifier - Intensifier circuit

UNIT IV **9 Hours**

PNEUMATIC SYSTEM AND COMPONENTS

Pneumatic Components: Properties of air - Compressors - Filter, Regulator, and Lubricator Unit - Air control valves, Quick exhaust valves, and pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method

UNIT V **9 Hours**

DESIGN OF PNEUMATIC CIRCUITS

Introduction to PLC - ladder diagrams, PLC applications in fluid power control. Fluid power circuits Failure and Trouble shooting. Fluidics - Introduction to fluidic devices, simple circuits. Servo systems - Hydro Mechanical servo systems, Electro-hydraulic servo systems and proportional valves

FOR FURTHER READING

Properties of hydraulic fluids - Pump classification -applications of Intensifier - Properties of air - Application of PLC

Total: 45 Hours

Reference(s)

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2006
2. S.R. Majumdar, Oil Hydraulics, Tata McGraw Hill, 2004
3. James L Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2003
4. S.R. Majumdar, Pneumatic systems Ã¢?? Principles and maintenance, Tata McGraw Hill, 2008
5. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2006
6. Illangov Soundarrajan, Introduction to Hydraulics and Pneumatics, Prentice hall of India, 2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	2				2	4				6				2				2				2			20
3	2				2					6				2	3							6			21
4		2			2					6				2	3							6			21
5		2				2				6				6								6			22
																								Total	100

Remember

1. Define the term fluid power.
2. Name three basic methods of transmitting power?

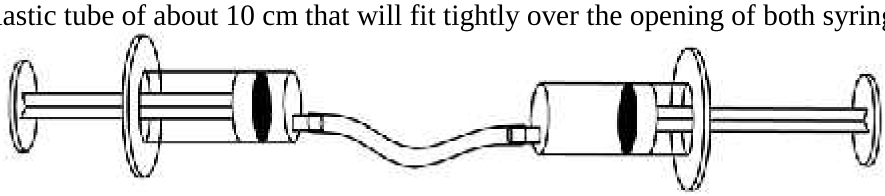
3. Define the term mass density.
4. Define the term absolute viscosity and kinematic viscosity.
5. Define surface tension, capillarity.
6. What is oxidation stability?
7. What are fluid power symbols?
8. State Pascal‘s law.
9. State the continuity equation.
10. What are the various energy losses occur when liquid flows through a pipe?
11. What is the function of pump?
12. What do you mean by slip?

Understand

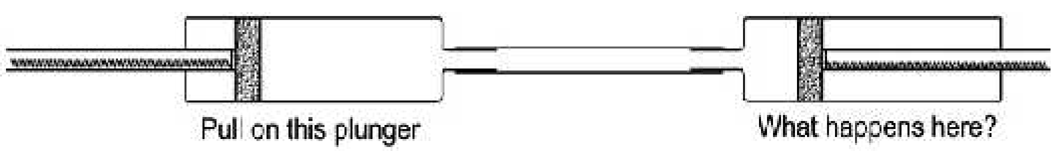
1. What is the fundamental difference between Hydraulics and pneumatics?
2. State the effect of temperature and pressure on viscosity of liquids?
3. What is the difference between the force and pressure?
4. Differentiate between the laminar and turbulent flow?
5. Where the hydrodynamic displacements pumps are employed? Why?
6. Which pump-external gear, internal gear, screw vane and piston –generates the least noise? Why?
7. Why are centrifugal pumps not preferred for fliud power application?
8. Why are double acting cylinders known as differential cylinders?
9. Which hydraulic motor is generally the most efficient? Why?
10. State the difference between the hydraulic motor and hydraulic pump?

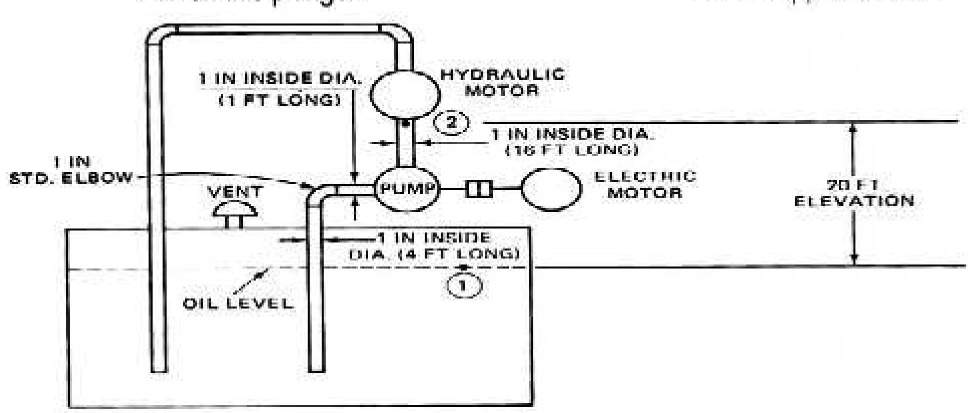
Apply/Evaluate

1. To investigate a hydraulic and pneumatic system Requirements: Two syringes of equal size. A plastic tube of about 10 cm that will fit tightly over the opening of both syringes.



Draw out the plunger (piston) of one syringe and push in the plunger of the other syringe. Connect the two syringes by means of the plastic tube. Push in the plunger of one syringe. Draw that plunger out again.





For the Hydraulic System shown, following data are given:
Pump is adding 5 hp (3730 W) to fluid Pump flow is 0.001896 m3/s Pipe has 0.0254 m inside dia Sp.Gravity of oil = 0.9 Kinematic viscosity of oil is 100 CS Elevation difference between station 1 & 2 is 6.096 m Pipe lengths: 1 ft = 0.305 m, 4 ft = 1.22 m, 16 ft = 4.88 m Find pressure available at inlet to hydraulic motor. The pressure at the oil top surface level in the hydraulic tank is atmospheric (01 MPa).

Create

1. The feed system of a press could be operated either manually or automatically with the following preconditions.
   - The press tool should be in position.
   - The work piece must be clamped.
   - No part of the operator's body should be in the working area.
2. Design a schematic circuit which will operate one spring return cylinder from any one of three identical valves.
3. Design a schematic circuit that requires the operator to push one of two buttons that in turn shifts a detented, two position, and four-way valve. The valve is air-piloted in both directions and operates a double acting cylinder. 4. Design and Assemble an ―Automatic Cam Cycling‖ circuit.

15EI011 INSTRUMENTATION AND CONTROL IN IRON AND STEEL INDUSTRIES 3 0 0 3

Course Objectives

- To know the role of instrumentation in a steel industry
- To understand the control operations carried out at various stages of iron and steel industry.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Recall the parts of instrumentation and their working in steel industry
2. Analyze the basic properties of steel and its measurement
3. Analyze the consistency measurement and control in steel industry
4. Examine the concepts of manufacturing steel in industry
5. Implement the different control technique involved in steel manufacturing process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	3		2	1		1	2		1	1
2	2	1	1	1	2		2	1		1	2		1	1
3	2	1	2	1	2		1	1		1	2		1	1
4	1	1	2	1	2		1	2		1	2		1	2
5	3	1	2	1	2		2	2		2	3		1	2

UNIT I **9 Hours**

INTRODUCTION TO FURNACES

Process description in diagrammatic and functional block details - raw materials preparation - operation of blast furnace (BF) and auxiliary units, including stoves - Basic oxygen Furnace (BoF) - Electric Furnace (EF) - Open Hearth Furnace (OHF) - relative merits of various steel making furnaces.

UNIT II **9 Hours**

CASTING AND ROLLING

Quality of steel - impurities present and allowed limits for usable steel - waste recycling. Continuous casting and batch casting of steel - primary and secondary rolling - features of cold rolling - steel finishing operations.

UNIT III **9 Hours**

MEASUREMENTS IN IRON AND STEEL INDUSTRIES

Identification of various process parameters in the industry - selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning - special gauges for measurement of thickness and shape - Control room layout for mill operations - graphic displays - alarm management.

UNIT IV **9 Hours**

CONTROL APPLICATION

Special applications for controls - Blast Furnace (BF) Stove combustion control system - gas and water control system in Basic Oxygen Furnace (BoF) - Mould Level control system in Strand Casting operations.

UNIT V **9 Hours**

COMPUTER APPLICATIONS

Evalution of computer applications in the industry - Review of data logging, SCADA, DDC and DCS. Practices for model calculating and data logging - steel rolling mill control - annealing process control - utilities management with computer systems

FOR FURTHER READING

The need for iron and steel in the civilised world - history of steel making - per-capita consumption of steel in India and in other countries.

Total: 45 Hours

Text Book(s)

1. Liptak, Bela G, Instrumentation in the Processing Industries, Chilton Publishers, 1973.

Reference(s)

1. Considine D. M., Process/Industrial Instruments and control Handbook, McGraw Hill, 5th edition 1999.
2. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education, 2013.
3. Robert H. Perry, D.W. Green and J.O. Maloney, Perry's Chemical Engineers, Handbook, McGraw Hill Inc, New York, 7th ed, 1998.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	4	2		1	4	2		1	2			1	1											20
2	2		2		2		4		5	3			4												22
3	1	2	1		3	4			3	4			2												20
4	2	2			2	5			2	5			2												20
5	1	3			3	2	3		3	1			2												18
Total																									100

Assessment Questions

Remember

1. Reproduce the functional block diagram to describe a steel making process.
2. Recall the auxiliary units of blast furnace.
3. Recognize the allowable limit of impurities in usable steel.
4. List the features of cold rolling.
5. Reproduce the essential measurement schemes in steel industries.
6. Recall the special applications for controllers.
7. State the importance of mould Level control system in strand casting operations.
8. List the applications of SCADA.
9. Define the term direct digital control.
10. Recall the annealing process steps.

Understand

1. Explain the process operation with its functional block diagram.
2. Indicate the steps to prepare raw material for steel making.
3. Classify the furnaces used in iron and steel industries.

4. Summarize the operation of blast furnace with a diagram and explain the usage of its auxiliary units.
5. Indicate the factors to decide the quality of steel.
6. Indicate the steps to identify the impurities present in steel.
7. Summarize the waste recycling process with a block diagram.
8. Explain the steel finishing operation.
9. Exemplify the weighing and proportioning.
10. Infer the need for special gauges in steel processing industry and explain the measurement schemes based on special gauges.
11. Explain the graphic displays used in steel processing industry.
12. Illustrate operation of mould level control system used in strand casting operation.
13. Identify the need for gas and water control system in basic oxygen furnace.
14. Summarize the evolution of computer based application in the industry.
15. Interpret meaning of data logging in process industries and infer the role of data logging.
16. Classify the benefits of DDC.
17. Explain the operation of DCS with its block diagram.
18. Summarize the data logging process with an example.
19. Represent utility management.
20. Explain the computer based utility management system.

Apply

1. Predict the various process parameters in steel industry.
2. Select the suitable method and instrument for measurement of pressure and temperature in steel manufacturing process.
3. Select the suitable instrument for measurement of flow and level in steel manufacturing process.
4. Construct suitable measurement systems for temperature and pressure measurement in steel industries and explain their operations.
5. Implement a suitable level/flow measurement scheme for steel industry.
6. Implement a control scheme for Blast furnace stove combustion.
7. Design a control scheme for gas and water control system in basic oxygen furnace.
8. Design a SCADA for switching an industrial motor,
9. Implement a digital control scheme for steel rolling mill and explain its controlling operations.
10. Demonstrate computer based annealing process control.

Analyse

1. Differentiate between basic oxygen furnace and electric furnace used in iron and steel industries
2. Outline the merits of each furnace used in iron and steel industries by relating with other furnaces.
3. Compare the electric furnace with open hearth furnace.
4. Compare the usable steel with other steels.
5. Differentiate between continuous and batch steel casting methods.
6. Compare primary and secondary rolling process used in steel industries.
7. Contrast the stove combustion control and water control systems.
8. Outline the control room layout for mill operation with necessary accessories.
9. Contrast data monitoring and data logging.
10. Integrate DDC with SCADA and explain its benefits.

Create

1. Generalize the procedure to design an alarm management system based on the given constraints.
2. Combine all the control schemes used in iron and steel industry and derive overall control using a DCS.

15EI012 POWER ELECTRONICS AND DRIVES 3 0 0 3

Course Objectives

- To obtain the switching characteristic of different types of power semi-conductor devices.
- To determine the operation, characteristics and performance parameters of AC, DC converters.
- To understand application of Power Electronics drives.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Distinguish between the principle operation of power semi-conductor devices
2. Analyze the operating principle of rectifiers.
3. Analyze the operating principle of choppers and cycloconverters.
4. Analyze the operating principle of inverters.
5. Identify the drives for various control applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2		3									
2	3		3		2									
3	3		3		2									
4	3		3		2									
5					2							1		

UNIT I **9 Hours**

POWER SEMI-CONDUCTOR DEVICES

Construction, Operation, Characteristics of Power Diode - DIAC- SCR - TRIAC - Power transistor, MOSFET and IGBT - Ratings of SCR - Series parallel operation of SCR, di/dt & dv/dt protection.

UNIT II **10 Hours**

CONTROLLED RECTIFIERS

Single Phase and Three phase uncontrolled converter - Single Phase and Three phase half and fully controlled converters - Single phase and Three phase dual converter operation - Effect of source inductance

UNIT III **9 Hours**

CHOPPERS AND CYCLOCONVERTERS

Principle of chopper operations - control strategies - Step up and step down chopper - Buck and boost switched mode regulators - cycloconverters , Single phase cycloconverters

UNIT IV **9 Hours**

INVERTERS

Single phase and three phase (both 120 deg mode and 180 deg mode) inverters - PWM techniques: Sinusoidal PWM modified sinusoidal PWM and multiple PWM - Current source inverters - Voltage source inverter - UPS.

UNIT V **8 Hours**

DRIVES

Introduction to DC drives - AC drives-Frequency control - Vector control- Stepper motor drives- Position control- Servo drives- applications

FOR FURTHER READING

Simulation of One Phase TCR/TSC Static Var Compensator - Four-Quadrant Chopper DC Drive - Three-Level PWM Converter and Dead Time - Brushless DC and AC Motor Drive

Total: 45 Hours

Reference(s)

1. Muhammad H. Rashid, Power Electronics Circuits, Devices & Applications, Prentice Hall of India, New Delhi, 2013.
2. Dr.P.S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi, 2012.
3. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics: Converters Applications and Design, Wiley India, New Delhi, 3rd edition, 2010.
4. Singh. M.D & Khanchandani, K.B Power Electronics Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010.
5. Singh. M.D & Khanchandani, K.B Power Electronics Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2008.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					6				4				6											20
2	2						4			6					4			4							20
3	4					6				4				4				2							20
4	2					4					4				6				4						20
5	4					4				4				4				4							20
																								Total	100

Assessment Questions

Remember

1. Define free wheeling diode.
2. Define firing angle of SCR.
3. List the advantage and disadvantage of PWM control.
4. State the applications of UPS.
5. Define extinction angle.

6. Define Cycloconverter. Give its applications.
7. What is dual converter? Mention its uses.
8. What are the control strategies of chopper?
9. List the advantages and disadvantages of a buck-boost regulator.
10. Define AC drive and DC drive.

Understand

1. Explain the switching characteristics of MOSFET.
2. Identify the structure of a TRIAC with relevant diagram and symbol. Explain the different operating modes of TRIAC with its V-I characteristics. Also discuss its advantages and disadvantages.
3. Infer the need of series and parallel operation of SCRs. Also explain their operation with V-I characteristics and string efficiency.
4. Indicate the effect of source inductance on the performance of a single phase fully controlled converter with the conduction of various thyristors during one cycle.
5. Explain the operation of single phase fully controlled rectifier with R, RL load.
6. Illustrate the operation of single phase dual converter with neat waveform.
7. Explain the operation of single phase semi converter and derive expressions for its average and rms output voltages.
8. Explain the principle of basic chopper circuit with relevant voltage and current waveforms. Also explain the various control strategies used to get the variation in the output voltage.
9. Classify the basic topologies of switching regulators and explain the operation of buck regulator with continuous load current using suitable waveforms.
10. With neat diagram and waveforms, explain three phase voltage source inverter, using SCR operating in180 degree conduction mode. Also, obtain the expression for rms value of output voltage.
11. Explain sinusoidal pulse width modulation as used in PWM inverters.
12. Illustrate the operation of current source inverter with neat diagram.
13. Explain the working principle of single phase cycloconverter.
14. Interpret stator voltage control techniques for the speed control of a 3-phase induction motor.
15. Describe stator frequency control for the speed control of a 3-phase motor and derive the expressions for motor torque, maximum torque and the slip at which it occurs.
16. Explain volts/hertz control for a 3-phase induction motor for its speed control.
17. Identify the principle of chopper opreration.
18. Illustrate the operation of single phase inverter in 180 degree with neat waveform.

Apply

1. A single-phase full converter is supplied from 230 V, 50 Hz, The load consists of R = 10 ???and a large inductance so render the load current constant. For a firing angle delay 0. Determine (1) Average output voltage (2) Average output current (3) Average and rms values of thyristor currents (4) The power factor.
2. A single phase half controlled thyristor converter is connected to a load of a 5ohm resistance, 1H inductance and 10V emf. Compute the average load voltage and average load current assuming continuous current operation for a triggering angle 45deg. Estimate the input power factor if the load current can be assumed to be constant. The supply voltage is 230V, 50Hz.
3. The full wave controlled bridge rectifier has an ac input of 120V rms at 60Hz and a 20ohm load resistor. The delay angle is 40deg. Determine the average current in the loads, the power absorbed by the load and the input power factor.
4. A resistive load of 10ohm is connected through a half wave SCR circuit to 220V, 50Hz, single phase source. Calculate the power delivered to the load for a firing angle of 60®.find also the value of input power factor

5. A dc chopper is turned on for 30µsec and off 10µsec. i) duty cycle ii) chopping frequency. A dc chopper of input voltage 200V remains on for 25msec and off for 10msec. Determine the average voltage which appears across the load.
6. A dc chopper circuit is operating on TRC principle at a frequency of 2KHz on a 220V dc supply. If the load voltage is 170V, compute the conduction and blocking period of thyristor each cycle.
7. A step up chopper is used to deliver load voltage of 500V from a 200V dc source. If the blocking period of the thyristor is 80µs, compute the required pulse width.
8. A step up chopper has input voltage of 220V and output voltage of 660V. If the non-conducting time of thyristor is 100µsec. compute the pulse width of output voltage. If the pulse width is halved for a constant frequency operation, find the new output voltage.
9. For type-A chopper, dc source voltage = 230 V, load resistance = 10 ohms. Take a voltage of 2 V across chopper when it is on. For a duty cycle of 0.4, calculate (A) average output voltage (b) rms value of output voltage and chopper frequency.
10. A step-up chopper has input voltage of 220 V and the output voltage of 660 v. If the conducting time of thyristor-chopper is 100 µs, compute the pulse width of output voltage. In case output-voltage pulse width is halved for constant frequency operation, find the average value of new output voltage. For the basic dc to dc converter, express the following variables as functions of Vs, R and duty cycle in case load is resistive:
    Average output voltage and current
    Output current at the instant of commutation
    Average and rms freewheeling diode currents
    Rms value of the output voltage
    Rms and average thyristor currents
    Effective input resistance of the chopper
11. Apply the suitable control scheme for controlling the speed of dc separately excited dc motor for above and below base speed.
12. Apply the suitable control scheme for controlling the speed of dc shunt motor for above and below base speed.

Analyse

1. Compare 120° and 180° modes of inverter operation.
2. Differentiate between half controlled and fully controlled converter circuits.
3. How is 12 pulse converters formed from 6pulse converters?
4. Compare VSI and CSI.
5. Compare single pulse width modulation over multiple pulse width modulation technique.

Create

1. Combine the waveform of single phase half controlled converter resistive load with inductive and capacitive load.
2. Generalize the operation of stepper motor drive frequency control and vector control.

15EI013 ELECTROMAGNETIC THEORY 3 0 0 3

Course Objectives

- To develop a skill set in analyzing and solving problems of static electric field and magnetic field using vector calculus, electromagnetic laws and appropriate co-ordinate systems.
- To manipulate Maxwells equations using vector calculus for the purpose of investigating static, time varying electric and magnetic fields.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Interpret the coordinate systems and vector calculus related to electric and magnetic fields.
2. Apply vector calculus to understand the behavior of electric fields
3. Assess the behavior of Static magnetic fields
4. Interpret the significance of Maxwell equations.
5. Explain the Electromagnetic wave parameters and poynting vector.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	2		1	1		1	2		1		1
2	1	1	1	1		1	2		1	2		1		1
3	2	1	1	2		1	2		1	2		1	1	2
4	3	2	1	2		2	2		1	2		2	1	2
5	2	2	1	2		1	2		1	2		2	1	2

UNIT I **9 Hours**

INTRODUCTION

Different co-ordinate systems: Cartesian coordinates, cylindrical coordinates, spherical coordinates - Vector calculus: Differential length, area and volume, line surface and volume integrals - gradient of a scalar, divergence of a vector and divergence theorem - curl of a vector and Stoke?s theorem - Laplacian of a scalar

UNIT II **9 Hours**

ELECTROSTATICS

Coulomb?s Law ? Electric field intensity ? Field due to point and continuous charges ? Gauss?s law and it?s applications to calculate electric field?Electric scalar potential ? Polarization-Boundary conditions-Poisson?s and Laplace?s equations ? Capacitance-energy density

UNIT III **9 Hours**

MAGNETOSTATICS

Magnetic field intensity â€“ Biotâ€“savart Law - Ampereâ€™s Law â€“ Magnetic field due to straight conductors, circular loop, infinite sheet carrying currentâ€“Magnetic flux density in free space, conductor, magnetic materials â€“ Magnetization-Boundary conditionsâ€“Magnetic vector potentialâ€“Magnetic forceâ€“Torque â€“Inductance-Energy density

UNIT IV **9 Hours**

ELECTRODYNAMIC FIELDS

Faradayâ€™s laws, induced EMF â€“ Static and dynamic EMF, Maxwellâ€™s equations (differential and integral forms) â€“ Displacement current â€“ Poynting theorem

UNIT V **9 Hours**

ELECTROMAGNETIC WAVES

Electro Magnetic Wave equations ? Wave parameters: velocity, intrinsic impedance, propagation constant ? Waves in free space, lossy and lossless dielectrics, conductors - skin depth - Poynting vector

FOR FURTHER DETAILS

Transformation of coordinates, Electric field intensity due to co-axial cylinder, Scalar magnetic potential, Maxwell? equation for sinusoidal time varying quantity, Skin effect, Transmission line parameters, Transmission line equations, input impedance

Total: 45 Hours

Reference(s)

1. William H. Hayt, Jr. John A. Buck, ?Engineering Electromagnetics", McGraw Hill Higher Education, 8th revised Edition, 2011.
2. K. A. Gangadhar, P.M. Ramanathan, ?Electromagnetic Field Theory?, Khanna Publishers, Sixteenth Edition, 2011.
3. Bhag Sing Guru and Huseyin R. Hiziroglu, ?Electromagnetic Field Theory Fundamentals?, Cambridge University Press, fourth Edition, 2010.
4. A.Joseph. Edminister and Vishnu Priye, ?Electromagnetics?, Special Indian edition, Schaum?s Outlines, Tata McGraw Hill, 2009.
5. Sadiku, ?Elements of Electromagnetics?, Third Edition, Oxford University Press, 2010
6. Kraus and Fleish, ?Electromagnetics with Applications?, McGraw Hill International Editions, Fifth Edition, 2008.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2										6								12						20
2		2				4								6					8						20
3		2								6									12						20
4	2						12			6															20
5	4									8					8										20
																								Total	100

Assessment Questions

Remember

1. State divergence theorem and stokes theorem.
2. List vectors in Cartesian coordinate, cylindrical, spherical coordinate systems
3. Define skin depth
4. State Coulomb’s Law and Gauss’s law.
5. State Faraday’s law
6. List the Boundary condition of electrostatics.
7. List the wave parameters for uniform plane waves
8. Reproduce the various magnetic material used in practices
9. Define Poynting vector?
10. State Biot–savart Law

Understand

1. Compare circuit theory and field theory
2. Illustrate the boundary condition for dielectric to dielectric
3. Exemplify the inductance of two conductors carrying current in same and opposite directions
4. Explain the boundary condition for dielectric to free space
5. Identify the relation between Cartesian and cylindrical coordinate systems
6. Identify the Maxwell’s equation for differential and point form.
7. Identify the Maxwell’s equation for time varying harmonic field
8. Illustrate the torque equation for rectangular loop.
9. Illustrate the magnetic field due to infinite sheet conductor
10. Illustrate the magnetic field due to circular loop conductor

Apply

1. Compute the validity of the divergence theorem considering the field D=2xy ax +x2ay c/m2 and the rectangular parallelepiped formed by the planes x=0,x=1,y=0,y=2 &z=0,z=3.Â
2. Find the electric field intensity at the point (0, 0, 5) m due to Q1 =0.35 µC at (0,4,0) m and Q2 =-0.55 µC at (3,0,0) m.
3. Construct the expression for the electric field due to a straight and infinite uniformly charged wire of length ‘L’ meters and with a charge density of +λ c/m at a point P which lies along the perpendicular bisector of wire.
4. Compute an expression for field intensity at any point 'p' with distance, h, metre due to a straight, uniformly charged wire at a linear density of +1, coulombs per meter length. Also, find E , if the point 'p' is along the perpendicular bisector of wire and if the conductor is infinitely long.
5. Execute the boundary conditions of the normal and tangential components of electric field at the inter face of two media with different dielectrics.

6. A uniform plane wave of 200 MHz, traveling in free space impinges normally on a large block of material having εr =4, μr =9 and σ =0. Find transmission and reflection co efficient of interface.
7. The magnetic field intensity in free space is given s H=H0sinθ at t A/m. where θ=ωt-βz and β is a constant quantity. Compute the displacement current density.
8. Given that potential V=10sinθcosΦ/r2 find the electric flux density D at (2,π/2,0)
9. The electric field in a spherical co-ordinate is given by E=rρr/5ε. Show that closed ∫E.dS=∫(?.E)dv.
10. Given A= 2rcosΦ+jrsinφ in cylindrical co-ordinates .for the contour x=0to1y=0to1 verify stoke's theorem.

Analyse

1. Determine the attenuation constant and phase constant for the uniform plane wave with the frequency of 10GHz in a medium for which μ=μ0, εr=2.3 and σ=2.54x10-4Ω/m
2. Assume that E and H waves, traveling in free space, are normally incident on the interface with a perfect dielectric with εr=3 . Determine the magnitudes of incident, reflected and transmitted E and H waves at the interface.
3. Conclude the relation between three variables E, V and D in electrostatic field.
4. Differentiate electric and magnetic circuits
5. Given a half-circle of charge density λ as shown, determine E at the origin.
   Conclude the potential at the centre of square, each side of square having charge density of λ c/m

Evaluate

1. Calculate the total current in a circular conductor of radius 4mm if the current density varies according to J=104/R A/m2.
2. A solenoid 25cm long, 1cm mean diameter of the coil turns a uniformly distributed windings of 2000turns. The solenoid is placed in uniform field of 2 tesla flux density a current of 5A is passed through the winding. Determine the
   A. Maximum torque on the solenoid
   B. Maximum force on the solenoid
   C. The magnetic moment on the solenoid.
3. A plane sinusoidal electromagnetic wave traveling in space has Emax = 150 μV /m
   (A) Find the accompanying H.
   (B) Propagation is in x-direction and H is oriented in Y-direction. What is the direction of E.
   Compute the average power transmitted.
4. Choose the best method of coordinate system
5. Determine the concept of magnetic field due to various types of conductor

Create

1. In a 2-dimensional rectangular bar analyze the electric field computation inside the rectangle bar at any point P due to surface charge distribution of +rs.
2. Create a parallel plate electrolytic capacitor having 2mm thick and 3 mm width εr= 1.2, d=2 m and calculate stress per m2 .
3. Design a solenoid used in process control system
4. Design a 11KV overhead transmission system and calculate the inductance per phase.
5. Design a suitable cable to carry the information from switching station to the consumer.

15EI014 DIGITAL CONTROL SYSTEM 3 0 0 3

Course Objectives

- To give basic knowledge in digital control system
- To impart necessary knowledge in stability analysis for discrete system
- To model systems in state space representation
- To provide a solution to state equations and to study various computational algorithms
- To know about the compensators in digital controllers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Explain the components and concepts related to the digital control system
2. Investigate the stability of the discrete time system
3. Formulate the discrete time system in state space form.
4. Compute the solutions of discrete time state space equation using state transition matrix and Cayley Hamilton theorem.
5. Design a digital compensator for the given system using frequency domain technique.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			2										
2	3		2	2								1		
3	3		3	2								2		
4	3		3	3								2		
5	3		3	3								2		

UNIT I **9 Hours**

DIGITAL CONTROL SYSTEM

Digital control system - sample and hold - analog to digital converter - digital to analog converter - quantizing and quantizing error - sampling process - frequency response of zero order hold - first order hold - PI, PD controllers - digital PID

UNIT II **9 Hours**

RESPONSE OF DISCRETE SYSTEM

Pulse transfer function of cascaded elements, closed loop systems - characteristic equation - relationship between s-plane and z-plane poles - unit step response of digital control system - stability of discrete system - Jury's stability test - Root locus technique for digital system

UNIT III **9 Hours**

STATE SPACE REPRESENTATION

State variable formulation of discrete system - decomposition of discrete transfer function - direct decomposition - cascade decomposition and parallel decomposition - solution of state equation by recursive method - state transition matrix and its properties

UNIT IV **9 Hours**

SOLUTION OF STATE EQUATION

Solution of discrete time state equation - evaluation of state transition matrix - transfer function matrix - Discretisation of continuous time system - Solution of discrete time state equation by Cayley Hamilton theorem

UNIT V **9 Hours**

COMPENSATION TECHNIQUES

Compensation by continuous network - compensation by digital computer - frequency domain technique of designing D(z)

FOR FURTHER READING

Simulation of types of digital controller - Simulation of discrete system to analysis the stability - Simulation of discrete time state equation - Simulation of compensation techniques

Total: 45 Hours

Reference(s)

1. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2012
2. K. Ogata, Discrete time control system, Pearson Education Asia, New Delhi 2011
3. I.J. Nagarath and M. Gopal, Control System Engineering, New age International P.Ltd, New Delhi 2011
4. Lawrence J. Kamm, Understanding Electro Ã¢?? Mechanical Engineering: An Introduction to Mechatronics, Prentice Ã¢?? Hall of India Pvt., Ltd., 2000
5. Nitaigour Premchand Mahadik, Mechatronics, Tata McGraw-Hill publishing Company Ltd, 2009

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2	2			2			2				2			2		2		4	20
2		3									2	2		2					2	2			2	5	20
3			3				2				2			6				2		2		3			20
4				2				2		2		2			4		3		2				3		20
5			2				2			2				3				3	3		2			3	20
																								Total	100

Assessment Questions

Remember

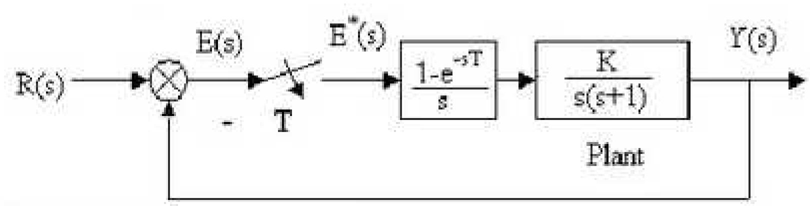
1. Label the types of sampling process.
2. State quantization.
3. Recall the relationship between S and Z plane.
4. List the types of stability analysis of digital control system.
5. Define state space analysis.
6. List the advantages of state space approach.
7. Define Cayley Hamilton theorem.
8. List the types of discretization.
9. Define Compensation.
10. Recall frequency domain specifications.

Understand

1. Indicate the symbolic representation of a ZOH and FOH.
2. Identify the transfer function of zero order hold device.
3. Infer the necessary condition for stability by Jury's stability test.
4. Illustrate the procedure for root locus techniques in digital system.
5. Classify the decomposition of discrete transfer function.
6. Summaries thestate transition matrix and its properties
7. Identify the solutions of discrete time equations.
8. Classify the methods to determine the state transition matrix.
9. Extrapolatethe information that can be obtained from frequency response plots.
10. Identify the factors to be considered for choosing series or shunt/feedback compensation.

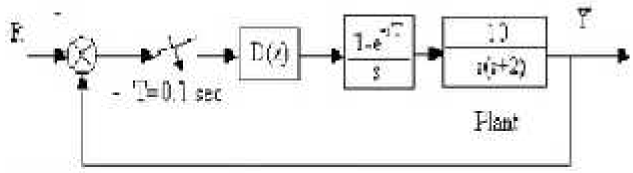
Apply

1. Implement the theorem required to satisfy to recover the signal e(t) from the samples e*(t).
2. Compute the pulse transfer function of digital PID controller.
3. Compute the pulse transfer function of two cascaded systems, each described by the deferential equation y (k) = 0.5y (k-1) + r(k).
4. Using Jury's stability criterion find the range of K, for which the characteristic equation $z^3 + Kz^2 + 1.5Kz - (K + 1) = 0$ is stable.
5. Show the root locus in the z-plane for the system shown in Figure for 0< K <∞. Consider the sampling period T = 4 sec.

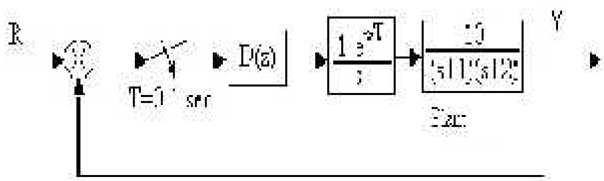


6. Find the state model for the deferential equation and also find its state transition matrix.
y(k+2) + 3y(k+1) + 2y(k) = 5u(k+1) + 3u(k).
7. Let A be an n*n matrix. Using Cayley Hamilton theorem show that any with k≥n can be written as a linear combination of $\{I, A, \ldots\ldots, A^{n-1}\}$
8. Consider a discrete linear discrete - data control system, whose input - output relation is described by the difference equation y (k+2) +2y (k+1) +y (k) =u (k+1) +u (k). Compute the following canonical models.
    i. Observable canonical form.
    ii. Controllable canonical form.

9. The block diagram of a digital control system is shown in the figure. Design a compensator D(z) to meet the following specifications:
   (a) Velocity error constant, Kv≥ 4 Sec.,
   (b) Phase margin≥ 40^0 and
   (c) Band width =1.5 rad. /sec

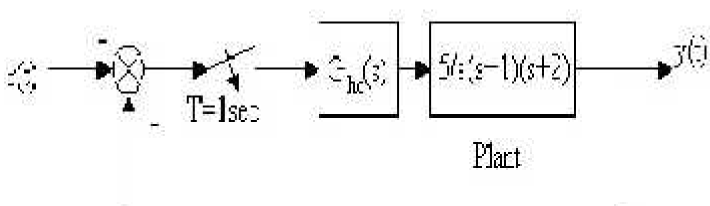


10. A block diagram of a digital control system is shown in Figure. Design a PID controller D(z), to eliminate the steady-state error due to a step input and simultaneously realizing a good transient response, and the ramp-error constant Kv should equal 5.



Analyze / Evaluate

1. Conclude in detail about implementation of control algorithms with an example.
2. A sampler and ZOH are now introduced in the forward loop show in Figure. Determine the stability of the sampled-data system via bilinear transformation and justify the stable linear continuous time system becomes unstable upon the introduction of a sampler and ZOH.



3. Determine the different state space representation of the of pulse transfer function $G(z)=(z+1)/[z^2+13z+0.4]$
4. Determine the discrete state and output equation of the system and pulse transfer function of the following continuous time system. G(s)=1/s(s+2)
5. Outline the stability analysis of a discrete time control system.
6. The open loop transfer function of a unity - feedback digital control system is given as

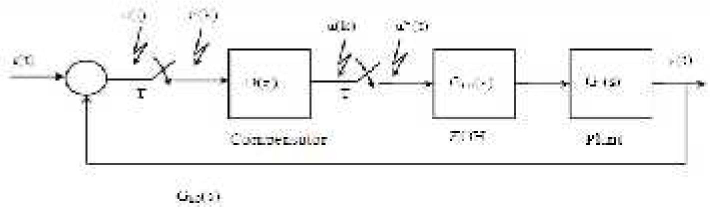
$$G(Z)=\frac{K(S+0.5)(Z+0.2)}{(Z-1)(Z^2-Z-0.5)}$$

   Check the root loci of the system for 0< K <∞. Indicate all important information on the root loci.
7. Determine the solution for discrete state space equation.
8. Determine the state transition matrix of the discrete system

$$x(k+1)=Gx(k)+Hu(k), y(k)=cx(k)$$

Where $G=\begin{bmatrix}0 & 1\\ -0.16 & -1\end{bmatrix}, H=\begin{bmatrix}1\\ -1\end{bmatrix}, C=\begin{bmatrix}1 & 0\end{bmatrix}$

9. Consider the feedback control system shown in Figure.



The plant is described by the transfer function G(s)=K / s(s+5). Integrate a digital control using frequency response plot for the system to meet the following specifications.

(a) Velocity error constant, Kv≥ 10
(b) Peak Overshoot≤25% and
(c) Settling time (2% tolerance band) ≤2.5sec

10. Conclude the design procedure of Digital Controllers using frequency response methods.

Create

1. Drive the necessary condition for the digital control system

$$X(k+1) = AX(k) + Bu(k)$$
$$Y(k) = CX(k) \text{ to be Controllable.}$$

2. The pulse transfer function of digital control systems is given by

$$G(Z) = \frac{5Z}{Z^2 + 3Z - 2}$$

Produce the various state space representations for the system and find the complete solution to a unit step input and assume that, the initial conditions are zero.

15EI015 DATA COMMUNICATION AND NETWORKS 3 0 0 3

Course Objectives

- To understand the various error controlling techniques in data communication networks
- To explain the function of various protocols
- To understand internet, email and its uses in modern communication

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Implement the principles of layered protocol architecture with respective roles in a communication system and calculate digital & analog transmission.

2. Identify error detecting and correcting methods in communication, control mechanisms for data link layer.
3. Analyze the various devices used in internet and their functions.
4. Analyze the services and features of the X.25, Frame Relay, ATM and SONET/ SDH of data networks.
5. Choose the protocol for different applications in data communication.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1										2
2	3	1	2	1										2
3	3	1	2	1										2
4	3	1	2	1										2
5	3	1	2	1										2

UNIT I **9 Hours**

OVERVIEW OF DATA COMMUNICATION

Introduction: Networks, protocols and standards, standards organizations - line configurations - topology - categories of networks - inter networks - OSI model: functions of the layers - encoding and modulation - digital-to-digital conversion, analog-to-digital conversion, digital-to-analog conversion, analog-to-analog conversion - transmission modes - transmission media: guided media, unguided media

UNIT II **9 Hours**

ERROR CONTROL AND DATA LINK PROTOCOLS

Error detection and correction: Types of errors, detection, Vertical Redundancy Check (VRC), Longitudinal Redundancy Check (LRC), Cyclic Redundancy Check (CRC), and check sum - error correction: single bit error correction - data link control: line discipline, flow control, error control - data link protocols: asynchronous protocols, synchronous protocols, and character oriented protocols, bit oriented protocols - link access procedures

UNIT III **9 Hours**

SWITCHING AND NETWORKS

Switching: Circuit switching, packet switching, message switching - LAN: IEEE 802, Ethernet, token bus, token ring, FDDI - MAN: IEEE 802.6, SMDS - networking and internet working devices: repeater, bridge, switch, router and gateway

UNIT IV **9 Hours**

X.25, FRAME RELAY, ATM AND SONET/ SDH

X.25: X.25 Layers - Frame relay: Introduction, frame relay operation, frame relay layers - congestion control - leaky bucket algorithm - traffic control - ATM: design goals, architecture, layers and applications - SONET/SDH: synchronous transport signals, physical configuration, layers and applications

UNIT V **9 Hours**

NETWORK, TRANSPORT AND APPLICATION LAYERS

Routing algorithms: distance vector routing, link state routing - TCP / IP protocol suite: overview of TCP/IP -
network layers: addressing, subnetting - application layer: Domain Name System (DNS), telnet, File Transfer Protocol (FTP), Trivial File Transfer Protocol (TFTP), Simple Mail Transfer Protocol (SMTP) and Simple Network Management Protocol (SNMP)

FOR FURTHER READING

Concept of Highway Addressable, Remote Transducer, HART and smart instrumentation HART protocol,Physical layer, Data link layer and its benefits - Troubleshooting of HART - Overview of Modbus protocol - Modbus protocol structure - Function codes and Read holding registers.

Total: 45 Hours

Reference(s)

1. Behrouz A. Forouzan, Data Communication and Networking, McGraw Hill Higher Education, New Delhi,2013
2. William Stallings, Data and Computer Communication, Pearson Education, New Delhi, 2013
3. Andrew Tannenbaum.S, and David Wetherall.J, Computer Networks, Pearson Education, New Delhi, 2012
4. Douglas E. Comer, Internetworking with TCP/IP Volume 1, Prentice Hall of India, 2006

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	14																			20
2		2			2	2				14															20
3	2	2			2	14																			20
4		2			2	2				14															20
5	2	2			2	14																			20
																								Total	100

Assessment Questions

Remember

1. Name the layers of OSI does the encryption/decryption process.
2. Identify which OSI layer is responsible for binary transmission, cable specification and physical aspects of network communication
3. Define PDU.
4. Label the types of flow control techniques that can be implemented in a network
5. Point the purpose of the preamble in Ethernet frame.
6. Outline the IEEE 802.2 standard represent in Ethernet technologies
7. Describe token pass in a token bus.
8. List the two functions of a router.
9. State the default port number for SMTP.
10. Point the purpose of HTTP protocol.

Understand

1. Demonstrate network topology which has a central device that brings all the signals together.
2. Distinguish Simplex, Half Duplex and Full Duplex transmission line modes.
3. Illustrate the error detection and correction methods designed for single bit detection or correction.
4. Represent the two features that make switches preferable to hubs in Ethernet-based network.
5. Indicate the incorrect VRC bit.
6. Distinguish between packet switching and circuit switching.
7. Classify the three WAN devices found in the cloud.
8. Paraphrase the two advantages of CIDR provided to a network.
9. Predict the primary disadvantage of telnet, when compared to SSH.
10. Express the port numbers included in the TCP header of a segment.

Apply

1. An 8-PSK system has an incoming data stream at 2400 bps. Compute the symbol rate of the transmitter?
2. A data link between the head office of a financial organization and one of its branches runs continuously at 2.048 Mbps. Between the hours of 0900 and 1700 it is noted that there are 295 bits received in error. Calculate the bit error rate.
3. Demonstrate how the Hamming code is used to correct a single-bit error in the data stream.
4. Sketch which type of switching network is followed by internet.
5. Show which type of switching that provides a constant bandwidth for the complete duration of a message transfer
6. When a collision occurs in a network using CSMA/CD, examine the hosts respond after the back off period has expired?
7. A network is configured with the IP, IPX and AppleTalk protocols. Manipulate routing protocol is recommended for this network.

Analyse

1. Classify the type of transmission mode of a telephone system.
2. Distinguish between connection-oriented transmission and connectionless transmission.
3. Point out which type of media is immune to EMI and RFI.
4. Contrast an analog signal with a digital signal.
5. Illustrate the two conclusions drawn when multiple errors detected in a transmission line.
6. A routing issue has occurred in you internetwork. Outline which type of devices should be examined to isolate this error.

Create

1. In LAN installations where potential electrical hazards or electromagnetic interference may be present, design type of media is recommended for backbone cabling.
2. A network administrator is required to use media in the network that can run up to 100 meters in cable length without using repeaters. The chosen media must be inexpensive and easily installed. The installation will be in a pre-existing building with limited cabling space. Design type of media would best meet this requirement.
3. Create the CRC-4 character for the following message using a “divisor” constant of 10011:
   1100 0110 1011 01
4. Design, construct and verify the operation of a parity generator circuit. The circuit allows selection of even or odd parity and indicates when a parity error occurs. Another option for the circuit is to operate with a choice of 7- or 8-bit data inputs.
5. A PC cannot connect to any remote websites, ping its default gateway or ping a printer that is functioning properly on the location segment. Explain the action will verify that the TCP/IP stack is functioning correctly on this PC?

15EI016 NEURAL NETWORKS AND FUZZY LOGIC 3 0 0 3

Course Objectives

- To provide the basics of neural networks and fuzzy logic
- To expose the concepts of feed forward and feedback neural networks
- To understand the concept of fuzziness involved in various systems
- To apply neural networks and fuzzy systems to model and solve the complicated practical problems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Analyse the fundamental concept of neural networks and neuro-modelling
2. Apply the concept of artificial neural network in control applications
3. Determine the concept of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning and fuzzy inference systems
4. Design fuzzy logic based controllers and explore their unique characteristics
5. Apply neural networks and fuzzy controller in real time application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1											
2	2	1	3											
3	2	3	1											
4	2	3		1										
5	1			2	3									

UNIT I **10 Hours**

ARTIFICIAL NEURAL NETWORK

Introduction - biological neuron and their artificial models - neuron modeling - learning rules - types of neural networks - single layer - multi layer feed forward network - back propagation - learning factors.

UNIT II **9 Hours**

NEURAL NETWORKS IN CONTROL APPLICATIONS

Feedback networks - Hopfield networks - applications of neural networks - process identification - artificial neuro controller for inverted pendulum.

UNIT III **8 Hours**

FUZZY LOGIC SYSTEMS

Classical sets - fuzzy sets - fuzzy operation - fuzzy relations - fuzzification - defuzzification - if-then rules.

UNIT IV **9 Hours**

FUZZY LOGIC CONTROL

Membership function - knowledge base - data base - rule base - decision-making logic - fuzzy logic controller: Mamdani and Sugeno-Takagi architecture.

UNIT V **9 Hours**

APPLICATIONS

Fuzzy controller for inverted pendulum, image processing, blood pressure during anesthesia - introduction to neuro-fuzzy controllers.

FOR FURTHER READING

Artificial neuro controller for real time control system - neuro-fuzzy modelling and control.

Total: 45 Hours

Reference(s)

1. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, New Delhi,2006.
2. John Yen, Reza Langari, Fuzzy logic Intelligence, control and Information, Pearson Education,1999.
3. H.J. Zimmerman, Fuzzy Set Theory-and its Applications, Kluwer Academic Publishers, New Delhi 2006.
4. B. Kosko, Neural Networks and Fuzzy Systems, Prentice Hall of India Ltd., New Delhi 2009.
5. B. Yagnanarayanan, Artificial Neural Networks, Prentice Hall of India Ltd., New Delhi 2012.
6. G.J. Klir and T.A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India Ltd., New Delhi, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	1	1		5	4	3			1	1				1			1							20
2	2	3	1		4	3	1			3					2			1							20
3	3	1	1		4	2	1				2			1	1			2							18
4	4	1	1		5	3	2		1				1				1	1							20
5	4	2	2		3	4	1				3				1		2								22
																								Total	100

Assessment Questions

Remember

1. List the three basic elements of a neuron model.
2. Define defuzzification.
3. List the types of defuzzification.
4. List the applications of neural networks.
5. List some of the multilayer neural network.
6. List the advantages of the Back propagation algorithm.
7. Recall the various properties of fuzzy sets.
8. List the various applications of fuzzy logic.
9. Label different types of learning rules.
10. State the output of AND function neuron and OR function neuron.
11. State Hebbian learning rule.
12. Define Linguistic variable.

Understand

1. Summarise the simplified model of an artificial neuron.
2. Interpret the training and classification of continuous perception with an example.
3. Explain the back propagation algorithm with your own training sets.
4. Illustrate the perceptron multilayer network with its algorithm.
5. Indicate the various steps involved in designing a fuzzy control system.
6. Represent the various methods of defuzzification.
7. Formulate the fuzzy rule for home heating system.
8. Indicate the operation of the fuzzy logic control with the process inference block.
9. Compute the role of knowledge based systems.
10. Explain the learning factors of neural network.
11. Represent the if then rules for fuzzy logic system.

Apply

1. Design the modeling of blood pressure control using neural network.
2. Find the techniques involved in pattern recognition.
3. Predict the necessity of fuzzy databases and explain.
4. Demonstrate the controller based inverted pendulum using fuzzy logic.
5. Construct the artificial neuro controller for inverted pendulum.
6. lUse the fuzzy controllers for controlling the blood pressure during anesthesia.
7. Select the suitable controller for controlling the inverted pendulum whether fuzzy or neural network.
8. Design the membership function for mamdani method with suitable examples.

Analyse

1. Predict the similarities and dissimilarities between fuzzy logic and neural networks.
2. Differentiate feed-forward and feed-back neural network.
3. Differentiate supervised and unsupervised learning.
4. Justify how does ANN resemble brain?
5. Compare single layer perceptron classifier with multi-layer perceptron classifier.
6. Compare sugeno or mamdani fuzzy logic controller.
7. Identify the advantages of neuro-fuzzy controller than the other controllers.

Evaluate

1. Compare Fuzzy sets with Crisp sets.
2. Judge the method which is suitable for decision making.

3. Choose the controller which is suitable for real time applications and justify by supporting the same.

Create

1. Generate the fuzzy rules for controlling the invereted pendulum.
2. Relate the Sugeno and Mamdani methods for creating membership function.
3. Argue which method is suitable for controlling inverted pendulum whether the fuzzy or neural network.
4. Generate and sketch the desirable state transitions between the vertices by assuming that the vertices of a three-dimensional bipolar binary cube are used to represent eight states of recurrent neural network with three bipolar binary neurons. The equilibrium states are p = [- 1 - 1 - 1] and q = [1 1 1].

15EI017 INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES

3 0 0 3

Course Objectives

- To understand the various unit operations in the paper industry
- To find the alternative sensors and transducers for various measurements
- To evolve the appropriate controls and schematics for specific applications
- To know the world-class paper mills employing IT-enabled applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Recall the parts of instrumentation and their working in paper industry
2. Analyze the basic paper properties and its measurement
3. Analyze the consistency measurement and control in paper industry
4. Examine the concepts of making paper in industry
5. Implement the different control technique in paper industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1	2									
2	3	2	2	1	1									
3	1	3	1											
4	2	3	2											
5	1	2	3	2	2									

UNIT I **9 Hours**

AN OVERVIEW OF PAPER MAKING PROCESS

Paper making process-Raw materials -Pulp separation-screening-Bleaching-Cooking-Chemical reaction-chippers-types of digesters-H factor and Kappa factors-Stock preparation-Instrumentation needs Energy conservation and paper quality control

UNIT II **11 Hours**

PAPER PROPERTIES AND ITS MEASUREMENT

Physical, electrical, optical and chemical properties of paper-Basic weight, thickness, density, porosity, smoothness, softness, hardness and compressibility-stress -strain relationship-Tensile strength, bursting strength, tearing resistance, folding endurance, stiffness and impact strength -Dielectric constant, dielectric strength, dielectric loss and Properties of electrical insulating paper - Brightness, colour, gloss and capacity Starch constant acidity and pH-Measurement techniques

UNIT III **5 Hours**

CONSISTENCY MEASUREMENT

Definition of consistency-Techniques for head box consistency measurement - Stock consistency measurement and control

UNIT IV **10 Hours**

PAPER MAKING MACHINE

Functioning of Paper making machine-Quality parameters-moisture, basic weight, caliper, brightness, colour, ash content, strength, gloss and tensile strength - Parameters monitoring Instrumentation

UNIT V **10 Hours**

CONTROL ASPECTS

Machine and cross direction control technique -consistency, moisture -and basic weight control -dryer control-computer based control systems Mill wide control.

FOR FURTHER READING

Conventional measurements at wet end-pressure-vacuum-temperature-liquid density-specific gravity-level-flow-consistency measurement

Total: 45 Hours

Reference(s)

1. Sankaranarayanan, P.E., Pulp and Paper Industries -Technology and Instrumentation Kotharis Desk book series, 1995
2. Handbook of Pulp and Paper technology, Britt K.W.Van Nostrand Reinbold Company, 1970

3. James P.Casey , Pulp and Paper chemistry and chemical Technology, John Wiley and sons, 1981
4. Austin G.T., Shrencs Chemical Process Industries, McGraw Hill International Student Edition, Singapore, 1985
5. B. Yagnanarayanan, Artificial Neural Networks, Prentice Hall of India Ltd .,New Delhi.2012.
6. G.J. Klir and T.A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India Ltd., New Delhi, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	1	2			1	6				2	6														18
2	2				2	2					6		2	2											16
3	1	1			1	2			1					2	6				6						20
4		2					6						2		12										22
5	1				1	2	4		2	6			2						6						24
																								Total	100

Assessment Questions

Remember

1. List the the types of wood used for making pulp.
2. State the objectives of bleaching the papers.
3. List any two temperature sensors used in paper industry mentioning the location of measurement.
4. Retrieve the raw materials to be considered for making paper.
5. Define the term consistency as used in paper and pulp industry.
6. Define pH of liquids and what is the pH value for pulp?
7. Recall the functioning of paper making machine.
8. Recognise the quality parameters of paper machine.
9. List types of valves used in pulp and paper making process.
10. Define condensate conductivity control.

Understand

1. Explain the pulping process with neat diagram.
2. Explain the different methods of pulp production to make different strengths and grades of paper with schematic diagram.
3. Explain with hardware the measurement and control of density, specific gravity and thickness in the pulp making process.
4. Explain the hardware used to monitor and control the pH of the pulp.
5. Compare head box consistancy measurement and stock consistancy measurement.
6. Explain the techniques for head box consistancy measurement.
7. Summarize the parameters monitoring instrumentation.
8. Explain in detail about paper making machine.
9. Illustrate the concept of mill wide control.
10. Explain in detail about flow measurement techniques used in paper industry

Apply

1. Compute the GSM weight of paper for the given details.
   Weight of reel in kgs = 25

Length of paper in meter = 30
Reel width in cms = 15

2. Compute H factor for a cooking process.
3. Find the suitable digester for a paper making process.
4. Demonstrate the stress-strain relationship for a paper.
5. Select a suitable technique for pH measurement.
6. Assess the head box consistancy measurement of paper.
7. Carry-out the functioning of paper making machine.
8. Predict the suitable parameters monitoring instrument for paper industry.
9. Design a computer based control design for paper mill.
10. Implement a conventional method for specific gravity measurement in paper industry.

Analyse

1. Outline the various process variable in paper making process. Also explain the benefits, difficulties and requirements of process control implementation in paper making process in details.
2. Compare the various types of transducers applied for the measurement of temperature in paper making process.
3. Differentiate head box consistancy measurement and stock consistancy measurement in paper industry.
4. Justify the need of quality control in paper industry.
5. Integrate the concept of paper making process.
6. Outline the parameters measuring instruments used in paper industry.

Evaluate

1. Determine the suitable method for measuring physical properties of paper.
2. Choose the appropriate instrument which is used to measure moisture content in paper.
3. Check whether the quality control in each process is needed for paper making industry?
4. Criticise the functioning of paper making machine.

Create

1. Derive the stress-strain relationship of paper
2. Relate H factor and Kappa factor of paper
3. Generalise the concept of computer control system in paper industry

15EI018 MICRO ELECTRO MECHANICAL SYSTEM 3 0 0 3

Course Objectives

- To get adequate knowledge about various etching techniques in micromachining.
- To understand the concept of micromachining techniques.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Explain the characteristics, electrical and mechanical concepts and materials used for MEMS design
2. Examine the working principle and applications of MEMS based electrostatic, thermal and magnetic sensors & actuators
3. Analyze the design principle and applications of MEMS based Piezoresistive and Piezoelectric sensors & actuators
4. Differentiate the four etching techniques and two fabrication methods used for micromachining
5. Compare the polymer MEMS and Optical MEMS based on materials used for fabrication, working principles and application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2			1							1	
2	3	1	2	1		1							2	
3	3	1	2	1		1							2	
4	3			1		1							2	
5	3	1	1	1		1							2	

UNIT I **9 Hours**

INTRODUCTION

Intrinsic Characteristics of MEMS - Energy Domains and Transducers - Sensors and Actuators - Introduction to Micro fabrication - Silicon based MEMS processes - New Materials - Review of Electrical and Mechanical concepts in MEMS - Stress and strain analysis - Flexural beam bending - Torsional deflection

UNIT II **11 Hours**

SENSORS AND ACTUATORS-I

Physical, electrical, optical and chemical properties of paper - Electrostatic sensors - Parallel plate capacitors - Applications - Interdigitated Finger capacitor - Comb drive devices - Thermal Sensing and Actuation - Thermal expansion - Thermal couples - Thermal resistors - Applications - Magnetic Actuators - Micromagnetic components - Case studies of MEMS in magnetic actuators

UNIT III **10 Hours**

SENSORS AND ACTUATORS-II

Piezoresistive sensors - Piezoresistive sensor materials - Stress analysis of mechanical elements - Applications to Inertia, Pressure, Tactile and Flow sensors - Piezoelectric sensors and actuators - piezoelectric effects - piezoelectric materials - Applications to Inertia, Acoustic, Tactile and Flow sensors - micro pumps

UNIT IV **8 Hours**

MICRO MACHINING

Silicon isotropic Etching - isotrophic wet Etching - Dry Etching of Silicon - Plasma Etching - Deep Reaction Ion Etching (DRIE) - Isotropic Wet Etching - Gas Phase Etchants - Case studies - Basic surface micro machining processes - Structural and Sacrificial Materials - Acceleration of sacrificial Etch - Striction and Antistriction methods - Assembly of 3D MEMS - Foundry process

UNIT V **7 Hours**

POLYMER AND OPTICAL MEMS

Polymers in MEMS - Polyimide - SU-8 - Liquid Crystal Polymer (LCP) - Parylene -Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors - Optical MEMS - Lenses and Mirrors - Actuators for Active Optical MEMS

FOR FURTHER READING

Design analysis of MEMS capacitive differential pressure sensor for aircraft altimeter - Diaphragm design for MEMS pressure sensors using Data mining tool

Total: 45 Hours

Reference(s)

1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2011
2. Nadim Maluf, An introduction to Micro electro mechanical system design, Artech House, 2011
3. Mohamed Gad-el-Hak, The MEMS Handbook, CRC press Baco Raton, 2012
4. Tai Ran Hsu, MEMS & Micro systems Design and Manufacture, Tata McGraw Hill, New Delhi, 2010
5. Julian w. Gardner, Vijay k. varadan and Osama O.Awadelkarim, Micro sensors MEMS and smart devices, John Wiley & son LTD, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	2				2	4				6					2			2							18
3	2				2					6				2	3							6			21
4		2			2					6				2	3			2				6			23
5		2				2				6				6								6			22
																								Total	100

Assessment Questions

Remember

1. Define MEMS
2. State sensor.
3. Define micro fabrication.
4. Define stress and strain.
5. Recall the significance of comb drives capacitive actuator.
6. Draw the micro technology subfields.
7. List out the types of flow sensors.
8. Recognize the acoustic sensor.

9. Recall micromachining process.
10. Define plasma etching.
11. Draw the various types of beams and their deflected shapes.
12. Outline the use of MEMS mirror chips in projection screen TVs
13. Define LCP
14. State PDMS
15. Draw the various types of beams and their deflected shapes
16. Define DRIE.
17. Define plasma etching
18. Recall micromachining process
19. Define inertia

Understand

1. Illustrate the materials and interfaces in a schematic microstructure.
2. Express the factors should be considered for selecting the tactile sensor
3. Discuss the lithographic patterning process.
4. Explain the assembly of 3D MEMS.
5. Summarize the fabrication process for a dual-valve unpowered micro flow system using parylene as structural layer.
6. Elucidate the different types of etching process.
7. Explain the need of optical MEMS.
8. Show the process for fabricating micro fluid channels using PDMS.
9. Explain the need of optical MEMS.
10. Summarize the fabrication process for a dual-valve unpowered micro flow system using parylene as structural layer.
11. Illustrate the materials and interfaces in a schematic microstructure
12. Compute the equation for the voltage difference between two parallel plates.
13. Summarize the fabrication process for a dual-valve unpowered micro flow system using parylene as structural layer.

Apply

1. Show the process for fabricating micro fluid channels using PDMS.
2. Interpolate the Structural tests using a MEMS Acoustic Emission Sensor.
3. Examine the traffic flow control using surface acoustic wave sensors.
4. Explain the MEMS application in pavement condition monitoring.
5. Interpolate the Structural tests using a MEMS Acoustic Emission Sensor
6. Use optical sensors for Pipeline implementation
7. Explain the Structural tests using a MEMS Acoustic Emission Sensor
8. Explain any four application of MEMS in consumer electronic products
9. Explain the role of optical sensors for Pipeline implementation
10. Explain the traffic flow control using surface acoustic wave sensors

Analyse

1. Determine how airbags systems are triggered using MEMS accelerometer chip
2. Compare different types of etching process
3. Differentiate electrostatic sensors and piezoresistive sensors
4. Point out the role of lithographic patterning process
5. Outline the factors should be considered for selecting the tactile sensor
6. Determine the speed of the car using MEMS accelerometer

Evaluate

1. Compare electrostatic sensors and piezoresistive sensors.
2. Design and carry out experiments requiring the assembly of custom fixtures, materials
3. Outline the process for fabricating micro fluid channels using PDMS.
4. Determine the equation for the voltage difference between two parallel plates

Create

1. Invent a model of an Analog Devices ADXL202 and be able to explain how a MEMS accelerometer works.
2. Design of heartbeat measuring transducer.

3 0 0 3

15EI019 INSTRUMENTATION IN AGRICULTURE

Course Objectives

- To get adequate knowledge about various sensors used in agriculture processes
- To have a knowledge about applications in micromachining techniques
- To know about automation process in agriculture field

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Interpret the necessity of instrumentation and sensor requirements in agriculture
2. Analyse the soil parameters and infer the soil sensor required for the field
3. Implement flow diagrams and instrumentation for various food process industries
4. Analyse and design systems/instruments for agriculture using SCADA.
5. Implement the appropriate electronic control circuits required for automotives used in agriculture

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	1	1	2	2					2	2	2
2	3	2	3	1	1	2	3					2	2	2
3	2	3	3	2	3	2	3					2	2	2
4	2	3	3	2	3	2	3					2	2	2
5	2	3	3	2	2	2	3					2	2	2

UNIT I **9 Hours**

AGRICULTURE FOR ENGINEERS

Introduction: Necessity of instrumentation and control for food processing - agriculture sensor requirements - remote sensing, bio sensors in Agriculture - standards for food quality

UNIT II **9 Hours**

SOIL SCIENCE AND SENSORS

Measurement of PH, conductivity, resistivity, temperature and soil - Moisture and salinity - Iron concentration -Measurements methods of soil analysis - Instrumentation for environmental conditioning of seed germination and growth

UNIT III **9 Hours**

PROCESSES AND INSTRUMENTATION

Flow diagram of sugar plant and instrumentation set-up - Flow diagram of fermented and control (Batch process) - Oil extraction plant and instrumentation set-up- Pesticides manufacturing process and control - Flow diagram of Diary industry and instrumentation set-up - Juice extraction control set-up

UNIT IV **11 Hours**

SCADA FOR AGRICULTURE

Application of SCADA for agriculture process parameters and control - Water distribution and management control - Auto-Drip irrigation systems - Irrigation Canal management - upstream and downstream control concepts and supervisory control

UNIT V **7 Hours**

AGRICULTURE AUTOMATION

Automation in Earth Moving Equipment and farm implements - pneumatic, hydraulic and electronic control circuits in harvesters, cotton pickers, tractors

FOR FURTHER READING

Green houses and Instrumentation: Ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control. Electromagnetic, radiation, photosynthesis, infrared and CV, bio sensor methods in agriculture.

Total: 45 Hours

Reference(s)

1. Perry G CIGR Handbook of Agricultural Engineering: Information technology, American Society of Agricultural Engineers, 2006 Digitized 12 Apr 2011
2. Johnson C. D.Process Control Instrumentation Technology 7th Edition, Pearson Education, New Delhi, 2013

3. Jonathan Love Process Automation Handbook: A Guide to Theory and Practice, springer, 2007
4. Liptak B. G.Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II, 2005
5. D.Patranabis Industrial Instrumentation Tata McGraw Hill publications, New Delhi, 2010
6. Nadim Maluf, An introduction to Micro electro mechanical system design, Artech House, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	6			2	6																			16
2	2				2	4				8				2				2					6		26
3	2					4				4				2	4										16
4		2			2					6				2	2								6		20
5		2				2				6				6									6		22
																								Total	100

Assessment Questions

Remember

1. Define standards for food quality
2. List any four uses of bio sensors in agriculture process
3. Define pH
4. Recall the resistivity of the soil
5. List any four merits of batch process
6. Define SCADA
7. Recall Auto-Drip in irrigation systems
8. Define pneumatic action
9. Recall automation in agriculture

Understand

1. With neat sketch illustrate the necessity of instrumentation and control in food processing
2. Indicate the requirements of sensors in agriculture processing
3. Explain any two measurement methods for soil analysis
4. Explain the role of the Instrumentation for environmental conditioning of seed germination and growth
5. Explain the Flow diagram and instrumentation set-up for sugar plant
6. Explain the various steps involved to construct Flow diagram and instrumentation set-up for fermented and control process
7. Explain about Pesticides manufacturing process
8. Explain about Water distribution and management control process
9. Explain Irrigation Canal management system
10. Explain Automation in Earth Moving Equipment and farm implementation process

Apply

1. Demonstrate remote sensing methodology in agriculture process
2. Execute any two methodology for moisture and salinity test of the soil
3. Execute instrumentation setup for oil extraction process
4. Demonstrate upstream and downstream control concepts and supervisory control
5. Demonstrate hydraulic control circuits in harvesters

Analyse

1. Differentiate bio sensors and transducers
2. Differentiate conductivity and resistivity
3. Attribute the steps involved to measure pH
4. Differentiate continuous and batch process
5. Attribute the steps involved to design control setup for juice extraction process
6. Demonstrate SCADA for agriculture process parameters and control
7. Differentiate electronic and hydraulic control
8. Attribute pneumatic, hydraulic and electronic control circuits in harvesters, cotton pickers, tractors

Create

1. Create hydraulic system for cotton pickers process
2. Create upstream and downstream control structure for agriculture process

15EI020 TOTAL QUALITY MANAGEMENT 3 0 0 3

Course Objectives

- To understand quality concepts and philosophies of TQM
- To apply TQM principles and concepts of continuous improvement
- To apply the quality tools, management tools and statistical fundamentals to improve quality.
- To understand the quality systems and procedures adopted.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Interpret the philosophy and core values of Total Quality Management (TQM)
2. Apply TQM principles for Customer satisfaction and continuous process improvement
3. Analyze the statistical process control methods (Six sigma,Normal Curve)
4. Apply quality tools (QFD,QPD)& management tools (TPM) to improve quality

5. Implement the quality management systems (ISO 9001:2008) and environmental management systems (ISO 14001:2004)

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		1	1				1	1		2	1		
2	1		1	1				2	3		3	1		
3	1		1	1				1	2		3	1		
4	1		1	1				1	3		3	2		
5	1		1	1				2	3		3	2		

UNIT I **9 Hours**

INTRODUCTION

Definition of Quality, Dimensions of Quality, Quality costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing

UNIT II **9 Hours**

TQM PRINCIPLES

Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS Partnering

UNIT III **9 Hours**

STATISTICAL PROCESS CONTROL

The seven tools of quality, New seven Management tools, Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma.

UNIT IV **9 Hours**

TQM TOOLS

Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking,Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA

UNIT V **9 Hours**

QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

FOR FURTHER READING

Basic statistics,Hypotheses,t Test,F test, one factor, two factors, full factorials, fractional factorials

Total: 45 Hours

Reference(s)

1. Dale H.Besterfiled,Total Quality Management, Pearson Education,2011
2. James R.Evans & William M.Lidsay,The Management and Control of Quality,South-Western (Thomson Learning), 2012.
3. J. S. Oakland,Total Quality Management, Butterworth?Hcinemann Ltd., Oxford. 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2		4			2	4				6						2								20
2		2								4			2						6				6		20
3	2			2			5								6					6			4		25
4			4				4						2				6							4	20
5		2				4					6								3						15
																								Total	100

Assessment Questions

Remember

1. List the steps of FMEA.
2. Define the quality dimensions.
3. State deming‘s philosophy
4. Label the 7 tools of QC.
5. Recall the various types of quality costs.
6. State the duties of quality council.
7. State 5s principles of quality management
8. Define benchmarking
9. Reproduce the concept of six sigma and its implications.
10. Retrieve the needs of ISO 9000 in quality

Understand

1. Abstract the evolution of TQM.
2. Represent the various process involved in ISO 9000 implementation and certification
3. Explain Taguchi‘s loss function.
4. Interpret the concept of optimum quality cost.
5. Indicate the various steps involved in bagging the deming‘s quality award.
6. Summarise the concept behind statistical fundamentals of quality management
7. Infer the reason for implementing kaizen in an organization to improve quality
8. Illustrate the various elements of system quality
9. Compare QFD with QPD
10. Represent the control charts for variables and attributes

Apply

1. Compute eight creative ideas for the improvement of quality in a field of your choice.
2. Implement your own ideas to provide quality system by applying the necessary principles and tools of TQM
3. Execute the team balancing concept in short notes
4. Carry out the layout (plan) of the company by your own ideas to provide quality systems by considering you as the production engineer
5. Demonstrate with an example to prove the importance of TQM in the current scenario.
6. Select the concepts of control chart available for problem solving to control the quality of statistical process with an example
7. Identify an external agency and implement the process of auditing for an educational institution by following the concern quality factors.
8. Execute your own ideas to improve the quality of the product
9. Choose the best method of handing to improve the Customer Retention

10. select an appropriate scheme to enhance employee involvement

Analyse

1. Organize the role of leadership in implementing TQM
2. Outline the steps involved in constructing a house of quality
3. Justify that the productivity improvement is due to total productive maintenance.
4. Differentiate between quality cost and quality council
5. Attribute your words to improve the customer satisfication based on various principles of TQM
6. Predict the tools of TQM and explain it
7. Show with an example that ISO 9000 and various other quality systems are necessary to improve quality

Evaluate

1. Support your own words to improve quality
2. Choose the best principles of TQM to satisfy the customer and eluciate the same
3. Determine the various techniques for implementation of quality systems
4. Determine the needs of ISO 9000 over other standard quality system
5. Judge your words to prove that the various quality standards are necessary to produce quality systems
6. Criticise the contribution of Demings over Juran

Create

1. Generate the plan for creating an organization is now thinking of adopting and implementing TQM practices.
2. Generalize the theme how you would go about carrying out this task, if you have been hired as an external consultant for this purpose?
3. Produce your own opinion about quality systems if various standards like ISO 9000 and ISO 9001:2004 where not processed.

15EI021 INSTRUMENTATION IN FOOD PROCESSING INDUSTRIES

3 0 0 3

Course Objectives

- To provide exposure to various techniques and methods that occurs in the various regions of food analysis
- To get an adequate knowledge about various techniques for analysis of food substances
- To understand the concepts of electrodes and biosensors that has potential applications in food and beverage industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Exemplify the Role of moisture content in food and also about the measurement of Turbidity and Humidity
2. Classify enzyme sensors, biosensors, Electronics Nose used in food manufacturing industries
3. Summarize the concepts of automatic controllers and Indicators used in food industry
4. Implement chromatography and mass spectrometry to the analysis of food products
5. Execute other Analytical Equipment like Scanning electron microscopy, Tandem Electron Microscopy

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	2
2	2	2											1	3
3	2	2											2	3
4	3	2											2	2
5	3	2											2	2

UNIT I **9 Hours**

MOISTURE, TURBIDITY AND HUMIDITY MEASUREMENTS

Role of moisture content in food - wet and dry method - IR technique. Humidity - Definitions - role in food processing - classical types - wet and dry bulb hygrometer - Electronic methods. Turbidity and colour: Definition and role, standards and units, basic turbidity meter, light scattering and absorbtion type

UNIT II **9 Hours**

FOOD ENZYMES AND FLAVOUR

Food enzymes and flavour : Human olfaction - Importance of enzyme sensors - biosensors -sensing arrays - Electronics Nose.

UNIT III **9 Hours**

CONTROLLERS AND INDICATORS

Basic control concept - Temperature controller in dryer - ration control in food pickling -atmospheric controller in food preservation.

UNIT IV **9 Hours**

CHROMATOGRAPHY AND MASS SPECTROMETRY IN FOOD INDUSTRY

Basics of gas and liquid chromatography - GC and HPLC Application in food analysis - MS application in food analysis

UNIT V **9 Hours**

OTHER ANALYTICAL EQUIPMENTS

Fourier transform Infra red spectroscopy, Scanning electron microscopy, Tandem Electron Microscopy

FOR FURTHER READING

X-ray fluorescence - Differential Scanning Calorimenter

Total: 45 Hours

Reference(s)

1. Nielsen, S.S,-Introduction to the chemical analysis of foods- Jones and Bartlett Publishers, Boston, London 2004.
2. Mahindru,S.N, -Food additives. Characteristics, detection and estimation-. Tata Mc Graw-Hill Publishing Company Limited, New Delhi 2000.
3. B.G.Liptak, ed -Instrument Engineers Handbook: Process Measurement and Analysis-, Butterworth &Heinemann, 1995
4. R G. Moreira, T.P Coultate Automatic Control for Food Processing System. 2001.
5. Willard, H.H., L. L. Merrit, J. A. Dean and F. L. Seattle, Instrumental Methods of Analysis, CBS Publishing Co, New York,2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	4				4				5								5							20
2		4				4				6				6											20
3	2	2				4				6				6											20
4		2				4				6												8			20
5	2	4				6			2	6															20
																								Total	100

Assessment Questions

Remember

1. Define moisture
2. List the techniques for determine the moisture content in food
3. List the various classical types of food processing
4. Reproduce the importance of enzyme sensors
5. Retrieve the basic concepts of controllers
6. State chromatography
7. List the application of chromatography and spectrometry in food processing industries
8. Define spectrometry
9. List the various analytical equipments of spectrometer
10. Expand the term a. GC b. HPLC c.MS

Understand

1. Identify the best method of moisture measurement and explain the same
2. Represent the few words to determine needs of instrumentation in food processing industries
3. Illustrate the few words about temperature controller in dryer
4. Abstract the concept behind GC and HPLC application in food analysis
5. Subsume the necessity of fourier transform Infra red Spectroscopy
6. Formulate the construction and working of scanning electron microscopy
7. Extrapolate the specialty of Tandem Electron Microscopy
8. Indicate the Difference behind the wet and dry bulb hygrometer
9. Represent the role of controller in food processing
10. Abstract Human olfaction

Apply/Analysis

1. Construct and explain the ratio control in food pickling

2. Compute the ideas of atmospheric controller in food preservation
3. Predict the controller which is suitable for food processing technique and explain the same
4. Design and explain Bio-sensors
5. Assess few words about sensing arrays
6. Justify your own words to prove that controller is very essential in food processing industries
7. Compare electronic nose and sensing arrays
8. Compare humidity and moisture
9. Outline the various standards and units of moisture, Turbidity and Humidity

Evaluate

1. Support by few word that instrumentation is essential in all processing industries with application
2. Choose the best method of chromatographic techniques and elaborate
3. Determine the basic concept behind the turbidity meter

Create

1. Relate the three analytical equipments of spectroscopy to evaluate them
2. Generate a plan to revoke the problem of food processing industries in the areas of instrumentation (Case Study)

15EI022 JAVA PROGRAMMING 3 0 0 3

Course Objectives

- Impart the fundamental concepts of core JAVA
- Gain programming skills in JAVA.
- Gain the built in knowledge of standalone and web applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Identify classes, objects, members of a class and relationships among them needed for a specific problem .
2. Demonstrate the concepts of OOPs with proper program structuring
3. Explore the concept of Input and Output in Java.
4. Develop programs using strings.
5. Implement programs in Applet, AWT and Event handlers in Java.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3											
2	1	2	3		2									
3	1	2	3											
4	1	2	3		2									
5	1	2	3		2							-		

UNIT I **9 Hours**

JAVA BASICS

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators - Control Statements -Introducing Classes - Methods and Classes

UNIT II **9 Hours**

OOPS AND MULTITHREADED PROGRAMMING IN JAVA

Inheritance: Basics - Using Super Ã¢?? Creating a Multilevel Hierarchy - Method overriding Ã¢?? Using Abstract Classes -Packages and Interfaces: Packages - Access Protection - Importing Packages- Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw - Multithreaded Programming: Creating Threads - Inter Thread Communication

UNIT III **9 Hours**

I/O AND EXPLORING JAVA.IO

I/O Basics - Reading Console Input -Writing Console output - Native Methods - I/ O Classes and Interfaces - File -The Byte Streams - The Character Streams - Using Stream I/ O - Serialization

UNIT IV **9 Hours**

STRING HANDLING

String Handling: Special String operations and Methods - Sting Buffer - Exploring java.lang: Simple type Wrappers -System - Math - Collections Framework: Collections Interfaces and Classes - Utility Classes: String Tokenizer - Date and Time

UNIT V **9 Hours**

APPLETS, EVENT HANDLING AND AWT

Applet Basics - Applet Architecture - Applet Display Methods - Parameter Passing - Event Handling Mechanisms -Event Classes - Event Listener - Working with Windows , Graphics , Colors and Fonts - AWT Controls - Layout Managers and Menus - JDBC Concepts

FOR FURTHER READING

Spring framework - Container concepts - DAO Support and JDBC Framework - An introduction to Hibernate 3.5 - Integrating and configuring Hibernate - Building a Sample Application

Total: 45 Hours

Reference(s)

1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2011
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010
3. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008
4. Herbert Schildt, Java, A Beginner's Guide, Tata McGraw Hill, 2007

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	2				2	4					6			2				4							20
3	2				2						6			2	3			6							21
4		2			2						6			2	3			6							21
5		2				2					6			6				6							22
																								Total	100

Assessment Questions

Remember

1. List the five buzzwords of java.
2. Define byte code
3. Define JVM.
4. List the three usage of native methods
5. Recognize the rules of using static keyword.
6. Recall final keyword
7. Label the three features of swing.
8. Label the three advantages of AWT in java.
9. Recall session tracking.
10. Define JDBC.

Understand

1. Classify the types of inheritance.
2. Compare Break and Continue statement in java.
3. Illustrate the exception handling in java with an example.
4. Illustrate the differences between method overloading and method overriding.
5. Represent InputStreamReader with an example.
6. Compare character streams and byte streams in handling input.
7. Classify the differences between equals () and == in java string in terms of their function and output.
8. Classify the differences between length() and capacity() in string buffer in terms of their function and output.
9. Explain parameter passing in applet.
10. Represent the choice controls in AWT.

Apply

1. Implement the concept of function overloading to add int, float and double datatype.
2. Demonstrate the access control specifier with an example program.
3. Show the usage of String args[] in main method to read characters using command line arguments.
4. Implement multi level inheritance for a banking system.
5. Construct a package to explain the four access specifier.
6. Execute native methods to change the value of a variable in c.
7. Demonstrate the creation of menus using AWT.
8. Demonstrate Applet Architecture.
9. Demonstrate the methods in string buffer and string.
10. Show the differences methods and package.

Analyse

1. Outline the differences between while and do while loop.
2. Compare if-then and switch case.
3. Java does not support multiple inheritance. Justify.
4. Contrast the keywords final and finally in terms of class, methods and exception.
5. Differentiate methods and native methods.
6. Compare string and string buffer in string manipulations
7. Organize the process of parameters passing in applet and methods.
8. Outline the creation of menus using AWT.

Evaluate

1. Determine the output of the following
   class Super {
   private int a;
   protected Super(int a) { this.a = a;Â }
   }
   class Sub extends Super {
   public Sub(int a) { super(a);Â }
   public Sub() { this.a=5;Â }
   }
2. Determine which can directly access and change the value of the variable name
   package test;
   class Target {
   public String name = "hello";
   }

Create

1. Generate the following output using class and methods
   0 1
   0 2 4
   0 3 6 9
   0 4 8 12 16
   0 5 10 15 20 25
   0 6 12 18 24 30 36
   0 7 14 21 28 35 42 49
   0 8 16 24 32 40 48 56 64
   0 9 18 27 36 45 54 63 72 81
2. Derive a program to find the longest substrings without repeating characters. Iterate through the given string, find the longest maximum substrings.
3. Given array is already sorted, and it has duplicate elements. Generate a program to remove duplicate elements and return new array without any duplicate elements. The array should contain only unique elements.

15EI023 FAULT DETECTION AND DIAGNOSIS 3 0 0 3

Course Objectives

- To understand different Fault Detection and Diagnosis methods
- To impart knowledge and skills needed to design and detect sensor and actuators faults using Structured residual approach and directional structured residual approach
- To give an overview about advanced level issues in Fault Detection and Diagnosis

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Understand the concept of fault detection and diagnosis systems
2. Select appropriate fault detection method for the given system
3. Design fault tolerant controllers for given processes using structured residual approach
4. Construct fault detection system using directional structured residuals
5. Analyze the advanced level issues in fault detection and diagnosis

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	2													
3	2	3	3											
4	2	3	3											
5	2	2	2											

UNIT I **9 Hours**

INTRODUCTION TO FAULT DETECTION AND DIAGNOSIS

Scope of FDD, Types of faults and different tasks of Fault Diagnosis and Implementation Ã¢?? Different approaches to FDD: Model free and Model based approaches - Classification of Fault and Disturbances - Different issues involved in FDD - Typical applications.

UNIT II **9 Hours**

ANALYTICAL REDUNDANCY CONCEPTS

Introduction - Mathematical representation of Fault and Disturbances: Additive and Multiplicative types - Residual Generation: Detection, Isolation, Computational and stability properties - Design of Residual generator - Residual specification and Implementation

UNIT III **9 Hours**

DESIGN OF STRUCTURED RESIDUALS

Introduction - Residual structure of single fault Isolation: Structural and Canonical structures - Residual structure of Multiple fault Isolation: Diagonal and Full Row canonical concepts - Introduction to parity equation implementation and alternative representation

UNIT IV **9 Hours**

DESIGN OF DIRECTIONAL STRUCTURED RESIDUALS

Introduction to Directional Specifications: Directional specification with and without disturbances - Parity Equation Implementation Linearly dependent column

UNIT V **9 Hours**

ADVANCED LEVEL ISSUES AND DESIGN INVOLVED IN FDD

Introduction to Residual generation of parametric fault - Robustness Issues - Statistical Testing of Residual generators - Applications of Neural and Fuzzy logic schemes in FDD - Case study

Total: 45 Hours

Reference(s)

1. Janos J. Gertler Ã¢??Fault Detection and Diagnosis in Engineering systemsÃ¢?? - 2nd Edition, Macel Dekker, 2014.
2. Chiang, Leo H., Richard D. Braatz, and Evan L. Russell. Fault detection and diagnosis in Industrial systems, Springer Science & Business Media, 2013.
3. Uwe Kiencke and Lars Nielson, "Automotive Control Systems for Engine, Driveline and Vehicle", Second Edition. Springer, 2005
4. Tom Weather Jr and Cl and C.Hunter, "Automotive Computers and Control System", Prentice Hall Inc., New Jersey, 2007.
5. Young A.P. and Griffths,L., "Automobile Electrical Equipment", English Language Book Society and New Press, 2005.
6. V.A.W.Hillier, "Fundamentals of Automotive Electronics"-Second Edition, Nelson Thomes ltd, United Kingdom, 2001.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	4				2	4				6				2								2			20
3	8				2					6				2	3										21
4		4			4					6				2	3								2		21
5		4				6				6				6											22
																								Total	100

Assessment Questions

Remember

1. Define FDD.
2. State stability properties.
3. List any two approaches to FDD.
4. Draw the residual structure of single fault Isolation

5. List the frequency domain specifications.
6. Define Passive Fault-tolerant Control.
7. Recall the function of State Observer.
8. Reproduce parity equation.
9. List any four types of faults in Control valves.
10. Define compensation of valve stiction.

Understand

1. Compare between Model free and Model based approaches to FDD.
2. Infer Residual Generation.
3. Compare Passive Fault-tolerant Control- Active Fault tolerant Control.
4. Indicate the relation between Structural and Canonical structures of single fault Isolation.
5. Illustrate Fault-tolerant Control Architecture.
6. Summarize the different types of faults in Control valves.
7. Indicate directional specification with and without disturbances.
8. Summarize Fault tolerant Control of Three-tank System.
9. Compare Generalized Likelihood Ratio Approach – Marginalized Likelihood Ratio Approach.
10. Explain Norms based residual evaluation and threshold computation.

Apply

1. Demonstrate Fault-tolerant Control Architecture.
2. Show the Mathematical representation of Faults and Disturbances.
3. Implement fault diagnosis system using State Observer – State Estimators.
4. Demonstrate Residual structure of single fault Isolation.
5. Construct Diagnosis and Fault-tolerant control architecture of chemical process.
6. Execute Fault-tolerant Control design against major actuator failures.
7. Show parity equation implementation and alternative representation in structured residuals.
8. Construct Fault tolerant Control of Three-tank System.
9. Execute Fault tolerance Principles for actuator compensation.
10. Design Diagnosis and Fault-tolerant control for chemical process.

Analyse

1. Differentiate Model free and Model based approaches to FDD.
2. Attribute Residual structure of multiple fault Isolation.
3. Contrast between passive and active Fault-tolerant Control.
4. Justify whether Likelihood Ratio Approach leads optimum threshold settings or not.
5. Outline the Fault-tolerant Control design against major actuator failures.
6. Compare Diagonal and Full Row canonical concepts.
7. Differentiate quantification and compensation in valve stiction

Create

1. Derive mathematical expression for Likelihood Ratio Approach.
2. Derive mathematical expression for Marginalized Likelihood Ratio Approach.
3. Combine active and passive fault-tolerant control structure for Three-tank System.
4. Relate Fault-tolerant Control design against major actuator failures.
5. Derive expression for Statistical methods based residual evaluation and threshold settings.

15EI024 INSTRUMENTATION SYSTEM DESIGN 3 0 0 3

Course Objectives

- To comprehend the design of signal conditioning circuits for the measurement of Level, temperature and pH.
- To develop the skills needed to design, fabricate and test Analog/ Digital PID controller, Data Loggers and Alarm Annunciator
- To make the students to familiarize in designing orifice and control valve sizing

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Design signal conditioning circuits for temperature sensors,pH sensor and V/I and I/V converters.
2. Construct temperature,level transmitter and Smart flow to generate Industrial standard form of signals
3. Design and develop of data logger and PID controller to control and acquire parameters
4. Exemplify the different types of flow measurement sensors and control valve sizing
5. Design and implementation of alarm and annunciation circuit using PLC and PLD

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2										1	1
2	2	3	2								2		2	2
3	2	3	2								2		1	2
4	3	2											2	2
5	2	3	2										2	2

UNIT I **9 Hours**

DESIGN OF SIGNAL CONDITIONING CIRCUITS

Design of V/I Converter and I/V Converter- Analog and Digital filter design and Adaptive filter design Signal conditioning circuit for pH measurement, Air-purge Level Measurement Signal conditioning circuit for Temperature measurement: Thermocouple, RTD and Thermistor calibration and installation procedure for Thermocouple and RTD- Cold Junction Compensation and Linearization software and hardware approaches

UNIT II **9 Hours**

DESIGN OF TRANSMITTERS

Study of 2 wire and 4 wire transmitters Design of RTD based temperature transmitter,thermocouple based temperature transmitter - capacitance based level transmitter and Smart flow transmitters

UNIT III **9 Hours**

DESIGN OF DATA LOGGER AND PID CONTROLLER

Design of ON / OFF Controller using Linear Integrated Circuits - Electronic PID Controller Microcontroller based digital two-degree of freedom PID controller - Microcontroller based Data Logger Design of PC based Data Acquisition Cards

UNIT IV **9 Hours**

ORIFICE AND CONTROL VALVE SIZING

Review of flow equations - Orifice, Venturi and flow nozzle Sizing: - Liquid, Gas and steam services Control valve sizing Liquid, Gas and steam services Rotameter design- Control valve noise design of safety relief valves.

UNIT V **9 Hours**

DESIGN OF ALARM AND ANNUNCIATION CIRCUIT

Alarm and Annunciation circuits using Analog and Digital Circuits Design of Programmable Logic Controller - Design of configurable sequential controller using PLDs

FOR FURTHER READING

3D scanning, 3D digitizing and Data fitting,. High speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies

Total: 45 Hours

Reference(s)

1. K.Ogata, Modern Control Engineering, Prentice Hall, Fifth Edition, 2012
2. M.Gopal, Digital Control and State Variable Methods: Conventional and Intelligent Control Systems, Third Edition, Tata Mc-Graw Hill, 2011
3. B.W.Bequette, Process Control: Modeling, Design and Simulation, Prentice Hall International series in Physical and Chemical Engineering Sciences, 2010
4. Jacobs, P. F. 1996, Stereolithography and other RP&M Technologies, ASME
5. P. G. Drazin, Nonlinear Systems, Cambridge bridge press, 2012

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					4					4			4											16
2	2					2				4					6				6						20
3	2	2			2						6			6					6						24
4		2					6				8				8										24
5	2						4			6									4						16
																								Total	100

Assessment Questions

Remember

1. Define Sensitivity
2. State Peltier effect
3. Define Self heating
4. State Seeback effect
5. Draw a circuit to convert voltage to current using op amp
6. Define Dew point.
7. Draw the calibration circuit of RTD
8. List out the advantages of Thermocouple
9. Outline the requirements of air in air purge level measurement.
10. Define linearization
11. List the features of capacitance based level transmitter
12. Describe the working principle of capacitance based level transmitter
13. Define transmitter
14. Name the three methods of capacitance based level measurement
15. List the metals used for Resistance Thermometers
16. Quote the equation for change in resistance of RTD
17. List the requirements of the conductor material employed in RTD
18. Draw the symbolic representation of level, flow, temperature and pressure transmitter.
19. List the methods used to extract signal from noise in thermocouple based temperature measurement.
20. List the materials required for calibration of RTD.
21. List the various types of thermocouples and the alloys used for manufacturing it.
22. List the types of transmitters
23. Define data logger.
24. Define standalone data logger.
25. Recognize the need for ADC and DAC in PC based data acquisition system.
26. Define Pressure recovery factor.
27. Define cavitation and flashing

Understand

1. Indicate the force balance equation involved in rotameter design.
2. Indicate the need for control valve characteristics.
3. Tell the drawbacks of valve over sizing.
4. Illustrate the design procedure involved in orifice sizing with the help of necessary equation
5. Explain the various aspects to be considered in control valve selection and need for sizing.
6. Recall the formulae for valve co-efficient in case of liquids, gases, steam and vapors in control valve sizing and explain the valve co-efficient of control valve.

7. Summarize the design of Rotameter using appropriate expressions and parameters involved.
8. Explain the design of orifice for a given flow condition of liquid services.
9. Discuss the design procedure for venturi and flow nozzle sizing in detail for gas services.
10. Explain the working of fire alarm panels.
11. Explain the working of annunciator panels in process control.
12. Indicate the expression for the output voltage of PI controller.
13. Indicate the expression for the output voltage of PID controller.
14. Explain an application of microcontroller based data logger using appropriate diagrams.
15. Explain two position controller by implementing it using op-amp circuits and appropriate resistance values.
16. Illustrate microcontroller based digital two-degree of freedom PID controller.
17. Outline the considerations for selecting capacitance probe in level measurement.
18. Illustrate the operating principle, advantages, disadvantages and applications of Capacitance based level transmitter.
19. Interpret the procedure for transmitter selection and explain about intelligent Transmitters
20. Summarize the various digital communication protocols employed in transmitters
21. Distinguish transmitters and transducers.
22. Explain the bubbler method of level measurement along with its signal conditioning circuit.
23. Explain in detail about the thermocouple sensors and the technique used to eliminate the effect of noise while measurement.
24. A type K thermocouple with a 75^0F reference produces a voltage of 35.56mV. Indicate the temperature?
25. Indicate the need of reference junction compensation.

Apply

1. Compute the seeback E.M.F for a material with α=50µV/^{o}C if the junction temperatures are 20^0C and 100^0C.
2. A voltage of 23.72mV is measured with a type K thermocouple at a 0^0C reference. Calculate the temperature of the measurement junction.
3. A J type thermocouple with a 25^0C reference is used to measure oven temperature from 300^0C to 400^0C. Compute the output voltages correspond to these temperatures?
4. Sketch the signal conditioning circuit for RTD
5. An RTD has α_0 =0.005/^{0} C, R=500Ω, and a dissipation constant P_D=30mW/^{0}C at 20^0C. The RTD is used in a bridge circuit such as that R_1=R_2=500Ω and R_3 variable resistor used to nullify the bridge. If the supply is 10V and the RTD is placed in a bath at 10^0C, Calculate the value of R_3.
6. If a type J thermocouple is to measure 1000^0 C at a -100^0C reference. Compute the voltage to be produced.
7. A type-J thermocouple is to be used in a measurement system that must provide an output of 2V at 200°C. A solid state temperature sensor system will be used to provide reference temperature correction. The sensor has three terminals. Supply voltage, output voltage and ground. The output voltage varies as 8mV/°C. Design the complete circuit.
8. Sketch the circuit for linear approximation of Resistance Temperature Detectors
9. A type S thermocouple with a -5^0 C reference measures 12.120mV. Calculate the junction temperature
10. A proportional derivative controller has a 0.4 to 2 V input measurement range, a 0-5 V output, K_p=5%/% and k_D=0.08%/(%/min). The period of the fastest expected signal is 1.5s. Compute the parameters and implement this controller with an op-amp circuit.
11. Use microcontroller based digital two-degree of freedom PID controller for an industrial application.

12. A ¾ inch chlorine line at 80ºF carries 200pounds per hour. The upstream pressure is 55psi and it discharges into a tank at atmospheric pressure. Compute the valve coefficient of control valve to be installed adjacent to the tank and recommend a valve type.
13. Examine the actual flow to standard flow conversion
14. Calculate the valve co-efficient for a valve that allow 150gal of ethyl alcohol per minute with specific gravity of 0.8 at maximum pressure of 50psi.
15. An equal percentage valve has a maximum flow of $50cm^3/s$ and minimum flow rate of $2cm^3/s$. If the full travel is 3cm. Calculate the flow at 1cm opening.

Analyse / Evaluate

1. Compute the seeback E.M.F for a material with $\alpha=50\mu V/^oC$ if the junction temperatures are 20^0C and 100^0C.
2. A voltage of 23.72mV is measured with a type K thermocouple at a 0^0C reference. Calculate the temperature of the measurement junction.
3. A J type thermocouple with a 25^0C reference is used to measure oven temperature from 300^0C to 400^0C. Compute the output voltages correspond to these temperatures?
4. Sketch the signal conditioning circuit for RTD

Create

1. Construct a PC based data acquisition card for an industrial application.
2. Design an orifice plate as per BS1042 for the application liquid (Sulphuric Acid)
   - Flow range:600-1500kg/min
   - Flow temperature-50°C
   - Co-efficient of volume expansion(2)-$1.8x10^{-5}$/°C
   - Density at 0°C -1.14g/cc
   - Room temperature-28°C
   - Diameter of pipe-15.24cm
   - Upstream pressure-$5.2x10^5$ Pa
   - Dynamic viscosity at 50°C -0.015g/cm
   - Pressure tapping-flange
   - Co-efficient of volume expansion(1)-$1.1x10^{-5}$/°C
   - Co-efficient of volume expansion(3)-0.00202/°C
3. Design a rotameter using the following data.
   Pipe diameter: 5.1cm
   r=2.55cm
   Differential pressure across rotameter-60cm WC
   ρ_f-920kg/m3
   ρ_p- $2850kg/m^3$ and $Q_{max}=2500x10^{-6}m^3/sec$

15EI025 BUILDING AUTOMATION 3 0 0 3

Course Objectives

- To understand the principles and application of Building Automation system and building process control
- To study the dynamic performance of building processes/systems, control fundamentals and building process control
- To get knowledge in security systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Develop HVAC system architecture for building automation with human comfort
2. Demonstrate and analyse the process model for heating, cooling and ventilation applications
3. Design and develop different architecture of fire alarm system using field and panel components
4. Identify the appropriate CCTV access control system design for different applications in security system aspects
5. Apply perimeter intrusion technology for advanced security system design applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3				1		1			1	1	1
2	2	2	3	1			1		1			1	1	1
3	2	3	3				1		1			1	1	1
4	2	2	3						1			1	1	1
5	2	3	3						1			1	1	1

UNIT I **9 Hours**

INTRODUCTION TO BUILDING AUTOMATION SYSTEM N

Fundamentals: Introduction to HVAC- Basic Processes (Heating, Cooling) Basic Science - Air Properties - Psychometric Chart - Heat Transfer mechanisms - Human Comfort: Human comfort zones - Effect of Heat, Humidity - Heat loss.

UNIT II **9 Hours**

PROCESSESES

Heating Process & Applications: Boiler, Heater - Cooling Process and Applications: Chillers - Ventilation Process and Applications - Central Fan System - AHU - Exhaust Fans - Unitary Systems - VAV, FCU - Energy Saving concept & methods - Lighting control - Building efficiency improvement - Green Building - Leadership in Energy and Environmental Design (LEED) Certification concept and examples

UNIT III **10 Hours**

FIRE ALARM SYSTEM (FAS)

Introduction to fire alarm system - Fire modes, History, Components, and Principles of operation FAS Components: Field Components, Panel Components and Applications. FAS Architectures: Types of Architectures, Examples. FAS loops: Classification of loops, Examples. Power Supply design for FAS. Cause & effect matrix: Examples. Fire Standards: FAS Design procedure in brief, NFPA 72A, BS 5839, Indian Standards

UNIT IV **9 Hours**

SECURITY SYSTEMS

Introduction to Security Systems, Concepts Access Control System: Access Components, Access control system Design. CCTV: Camera: Operation & types, Camera Selection Criteria, DVR Based system, DVM, Network design, Storage design and CCTV Applications

UNIT V **8 Hours**

PERIMETER INTRUSION MS

Concept, Components, Technology and Advanced Applications Security Design: Security system design for verticals

FOR FURTHER READING

Applications of Building Management Systems

Total: 45 Hours

Reference(s)

1. 1. Reinhold A. Carlson, Robert A. Di Giandomenico, Ã¢??Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs)Ã¢??, R.S. Means Company, Inc 2012
2. William B. Riddens, Ã¢??Understanding Automotive ElectronicsÃ¢??, Sixth Edition, Butterworth Heinemann Woburn, 2010.
3. Michael F. Hordeski, Ã¢??HVAC Control in the New MillenniumÃ¢??, First edition, Fairmont Press, 2011.
4. NJATC Building Automation Control Devices and applications , First edition, Amer Technical Pub, 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				4	2				6				4				4						24
2		2				2	6			2	4			4											20
3		4				4	2			4				4											18
4	2	2				4					5			5											18
5	2	2				4	4			4					4										20
																								Total	100

Assessment Questions

Remember

1. Define intelligent building.
2. Recall BAS.
3. List the different systems in BAS.
4. List the different types of mounting for humidity sensors in BAS.
5. Recall Fire.
6. Label the conventional Fire Alarm System
7. List the component within Fire Alarm System
8. List the basic Component of Access Control System.
9. Label the basic components of CCTV system.
10. List the types of Camera.
11. List the types of cameras.

Understand

1. Illustrate the evolution of intelligent buildings.
2. Summarize the importance of each system in BAS.
3. Explain the process of BAS design.
4. Illustrate the working principle, characteristics of different types of temperature sensors- RTD, Thermister, Thermocouple, Bimetallic strip.
5. Explain the working principle of Dry bulb & Wet bulb Psychrometer.
6. Explain different types of mounting for air & water flow meters Measurement of CO2 level in air.
7. Explain the operation of different modes in AHU
8. Illustrate the working of different types of AHU with combination of- 100% outdoor air, mixed air, constant volume, variable volume, dual duct, single duct.
9. Explain the Heat recovery techniques.
10. Summarize the concept of Variable Air Volume (VAV) system.
11. Illustrate the design and working of radiation coil and chilled beam.
12. Illustrate the design and working of CRAC unit and VRV systems.
13. Illustrate the design and working of unit heater, Fan coil unit and unit ventilator.
14. Describe various terminal unit systems
    - CAV
    - VAV
    - FCU
    - UV
15. Explain the Architecture of BAS system.
16. Classify the Fire Alarm System.
17. Exemplify FAS architecture and its types.

18. Exemplify the Fire Alarm System loops
19. Explain the working Principles of Fire Alarm devices and its working Application in building safety.
20. Explain the basic concepts of Access Control System.
21. Illustrate the features and working principle of Access Control System Devices.
22. Explain the system Architecture of Access Control System.
23. Explain the system Architecture of CCTV System.
24. Summarize Video Management Systems (VMS).
25. Explain the CCTV System Architecture.

Apply

1. Design the comfort parameters for human being- temperature, humidity, flow, pressure, clean air, Co2%.
2. Design the different components in AHU- damper, filter, cooling coil, heating coil, fan, heat recovery wheel, and humidifier.
3. Find the battery calculations and its requirement and design
4. Assess the difference between Straight cable and Cross Cable.
5. Find the camera calculations parameters in VMS.
6. Identify the cable used in Access Control System.
7. Find the cause and effect Matrix-Fire alarm system.
8. Mention the uses of different types of VAV- CAV.
9. Find the parameters affecting building operation.
10. Show the role of different stakeholders in BAS system design.

Analyse

1. Compare intelligent architecture and structure.
2. Construct the stages of Fire Alarm System
3. Outline the components of fire alarm detection system, SLC wiring and its classification.
4. Conclude the technology and application of Intrusion systems.
5. Conclude the benefits of Access Control System.
6. Compare the classification of FAS loops.
7. Compare the various terminal unit systems
8. Outline the basic Fire Alarm System.
9. Conclude the need of Fire alarm System.
10. Conclude the need of Access Control of System.

Evaluate

1. Determine the power supply requirement and its designing parameters.
2. Choose the terminology for Cameras.
3. Choose the Fire terminologies.

15EI026 FIELD INSTRUMENTS AND PROCESS AUTOMATION 3 0 0 3

Course Objectives

- Execute the procedure to configure and calibrate the transmitters type field instruments
- Design two types of classical controller for different control schemes
- Select appropriate valve (Pneumatic or Electric) and communication protocol for different industrial application
- Execute PLC and SCADA configuration for Honeywell ML 200 and 200R
- Implement hardware interface and communication protocol of PLC and SCADA in industrial application

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Execute the procedure to configure and calibrate the transmitters type field instruments
2. Design two types of classical controller for different control schemes

3. Select appropriate valve (Pneumatic or Electric) and communication protocol for different industrial application
4. Execute PLC and SCADA configuration for Honeywell ML 200 and 200R
5. Implement hardware interface and communication protocol of PLC and SCADA in industrial application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	2	2	2	1	1	1	1	1			1
2	1	2	2	2	2	2	1	1	1	1	1			2
3	2	2	1	2	1	2	1	2	1	1	1		1	2
4	2	3	2	2	2	3	1	2	1	2	1		1	3
5	2	3	2	3	2	3	1		1	1	2		2	3

UNIT I **9 Hours**

FIELD INSTRUMENTS

Hands on training for configuration - commissioning - troubleshooting - calibration - Pressure transmitter - Temperature transmitter - Level transmitter - Flow transmitter - pH measurement - Humidity –Vibration

UNIT II **8 Hours**

CONTROL SCHEMES

Controllers - two position - PID - Tuning of PID - Process characters - Single capacity process - Multi capacity process - Feed back - Feed forward - Cascade - Ratio - Split range

UNIT III **8 Hours**

FINAL CONTROL ELEMENT AND INDUSTRIAL COMMUNICATION

Control valve - Solenoid valve - Motor operated valve - Actuators (Pneumatic & Electric) - Serial communication - Device net - Field bus - MOD bus - Profi bus - Ethernet - Fault Tolerant Ethernet (FTE)

UNIT IV **10 Hours**

PLC AND SCADA

Introduction to PLCs - ladder logic programming - PLC system configuration - PLC hardware configuration - Identify Honeywell ML 200 PLC CPU, I/O Modules, Communication modules - Plan the ML 200R PLC including the selection of appropriate I/O, redundancy and communications - ML 200R configuration and use of soft master Programming tool

UNIT V **10 Hours**

PLC HARDWARE INTERFACING

Building a project, implementing redundancy functions and downloading to PLC - Monitoring basics (Start/Pause/Resume/Stop monitoring), online editing, and force I/O - Debugging basics, use of breakpoints, reset and clear PLC - Identify function blocks in library - Use of PID function block - Communicate via SNET, FENET, Profi bus - DP modules -Overview of SCADA system

FOR FURTHER READING

Hydraulic systems troubles - landing gear troubles -cabin conditioning troubles - indication of unsafe canopy - Boeing condition - Radio troubles - Separate generator - System troubles - Trouble indicator light - Advantages of instrumentated flight - Black box and its use.

Total: 45 Hours

Reference(s)

1. 1. Curtis D. Johnson, Process Control Instrumentation technology, Pearson new international edition, 2013
2. 2. George Stephanopoulos, Chemical Process Control, PHI learning Pvt. Ltd., New Delhi, 2012
3. 3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes/Elsevier, 2013
4. Lin.C.F, "Modern guidance, navigation and control processing", Prenticehall, 1991.
5. John.H. Blakelock, "Automatic control of aircraft and missiles", John wiley and sons.inc, 1991.
6. Keyton.M and Walker.R, Fried,"Avionics navigation systems",John Wiley, 1996.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		3	4	2			4	4				1			1				1			23
2	1	1	1		4	4	3		1	2					2							1			20
3	1	1	1		2	2	1			2	2			2	1			1				1			17
4	5	3	2		3	1	1		1				1	2	1		1	1				1			23
5	1					3					3				7			2				1			17
																								Total	100

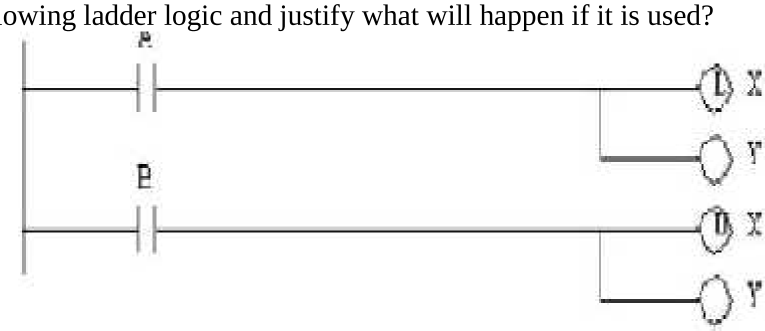
Assessment Questions

Remember

1. Quote, why process control is needed in industries?
2. List the characteristics of ON-OFF controller?
3. Describe the relationship between proportional band and proportional gain.
4. List the merits and demerits of P, I and D controllers.
5. Match the feed forward and feedback control system.
6. Recall the undesirable effects of dead time in a process.
7. Point an actuator.
8. Define PLC.
9. List out the advantages of PLC over relays.
10. Outline the use of Local Control Unit (LCU).
11. List out the programming languages used in PLC.
12. Identify the components involved in PLC.
13. Point the features and applications of SCADA.
14. List the advantages of SCADA.
15. What are the rules addressed for operating a communication system?
16. Define protocol.
17. Describe the basic requirements of communication protocol.

Understand

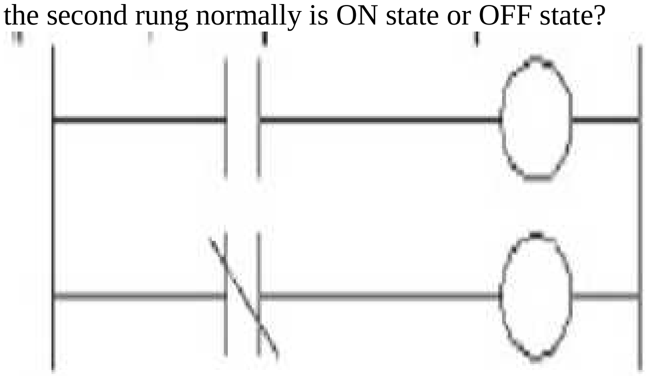
1. Discuss the principles and working of differential pressure transmitters.
2. Infer the difference between manipulated variable and controlled variable.
3. Judge when a PID controller is preferred rather than PI controller.
4. Distinguish between offset and error.
5. Select a suitable control schemes for temperature process and flow process.
6. Tell how the offset can be minimized with P-I controllers.
7. Judge what type of controller is preferred in the inner loop of cascade control?
8. Represent, how the feed forward controller improves the performance of a process.
9. Generalize the purpose of final control element in a process.
10. Elucidate the trade-offs between relays and PLC for control applications.
11. Explain why a stop button must be normally closed and a start button must be a normally open.
12. Express the following ladder logic and justify what will happen if it is used?



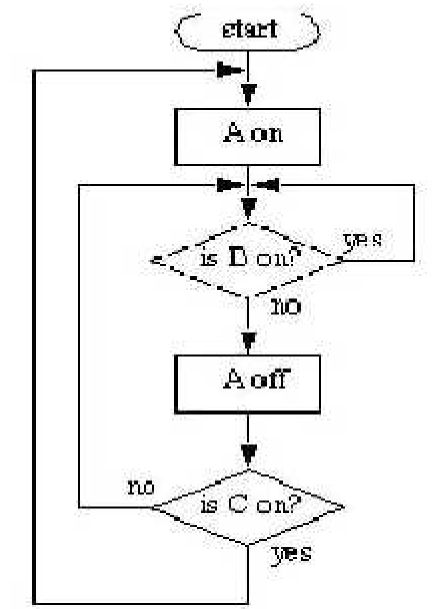
13. Give a concise description of a PLC.
14. Discuss Programming timers and counters.
15. Express the necessity of reset instructions for all timers and counters.

Apply

1. A tank operating at 50 feet head 51 lpm out flow through a valve and has a cross section area of 10 square feet calculate the time constant
2. Use the split-range controller to a pressure control process and explain its operation.
3. Examine where can be PLC used in the place of relays?
4. In the figure below, will the power for the output on the first rung normally in ON state or OFF state?
5. Would the output on the second rung normally is ON state or OFF state?



6. Convert the following flow chart to ladder logic.



7. If a counter goes below the bottom limit which counter bit will turn on?
8. Demonstrate the bottle filling system using PLC.
9. How are the program control instructions, math instructions and sequencer instructions used to execute certain functions in PLC and SCADA?

Analyse/Evaluate

1. Analyze why two interacting capacities have more sluggish response than non-interacting capacities.
2. Select the most appropriate types of feedback controller and controller settings for any process.
3. Illustrate the Proportional, PI, PD and PID controllers.
4. Identify the most suitable control valve for any flow process.
5. How are the program control instructions, math instructions and sequencer instructions used to execute certain functions in PLC and SCADA?
6. Differentiate PROFI bus and MOD bus.
7. Compare timers and counters.
8. Differentiate between PLC and SCADA.
9. Compare the address capability of different protocols.
10. Ladder logic outputs are coils. Justify.
11. Can seismic instrument act as an vibrometer? Justify.

Create

1. Design a simple PID controller to maintain the position of an inverted pendulum vertically.
2. Design a pressure transmitter to provide 0-5V for 0 -50 psi pressure variations using LVDT and elastic type conversion elements. Sensitivity of the elastic material is 0.1mm/psi and sensitivity of LVDT is 1mV/mm. (C)
3. Create a simple program that will use one timer to flash a light. The light should be on for 1.0 seconds and off for 0.5 seconds. Do not include start or stop buttons.
4. Design a digital PID using PLC for temperature process.
5. Invent ladder logic that uses a timer and counter to measure a time of 25 days

15EI027 INTERNET OF THINGS 3 0 0 3

Course Objectives

- To impart knowledge in Internet of Things(IoT)
- To understand the concept of interfacing smart sensors/actuators with internet connectivity
- To illustrate the various protocol standards deployed in the Internet of Things (IoT) domain

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Compare the IoT with M2M by analyzing the characteristics, functional blocks and architectural models of IoT
2. Examine the various design levels, physical devices and technologies used for IoT
3. Analyze the design principles of various connected devices used in IoT
4. Analyze the various communication protocols & standards used for IoT design
5. Apply IoT design principles in various domain and infer the challenges in real time implementation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1												1	
2	3		2			1							1	
3	2	2											2	
4	1	2	3		2								1	1
5	1	2	3	2	2	2							3	1

UNIT I **9 Hours**

INTRODUCTION TO INTERNET OF THINGS

Introduction to Internet of Things: Overview of Internet of Things, defining characteristics, connected things, functional blocks, architectural models, communicating APIs, Comparing Internet of Things and Machine to Machine (M2M) connectivity, Differences between IoT and M2M.

UNIT II **9 Hours**

DESIGN OF INTERNET OF THINGS

Design of Internet of Things: Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and Deployments, Introduction to Physical Devices and Endpoints.

UNIT III **9 Hours**

DESIGNING CONNECTED DEVICES

Designing Connected Devices: Basic Design Principles, Embedded Computing basics, Prototyping, Embedded prototyping, Sensors, Actuators, Beagle Bone Black, Development Options, Online Prototyping tools and components, APIs, Moving to the market needs, CC3200 SoC WiFi Controller with Cloud connectivity.

UNIT IV **9 Hours**

VARIOUS PROTOCOL STANDARDS AS ENABLERS OF IOT

Various Protocol Standards as enablers of IoT: Overview of Internet communications ÃƒÂ¢?? TCP/IP and UDP, Static and Dynamic Assignment, IP Address, IPv4 and IPv6, Wireless Communication Standards for IoT ÃƒÂ¢?? WiFi Connectivity include Servers with CC3200.

UNIT V **9 Hours**

DOMAIN SPECIFIC IOT AND THEIR CHALLENGES

Domain Specific IOT and their challenges: Illustrated Domains ÃƒÂ¢?? Home Automation, Smart Cities, Environment, Energy, Retail, Logistics, Health and Life Style, Industrial IoT ÃƒÂ¢?? CC3200 across various applications segment.

FOR FURTHER READING

Application of Internet of Things in Industries.

Total: 45 Hours

Reference(s)

1. Samuel Greengard, The Internet of Things (Essential Knowledge), MIT Press, 2015.
2. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, 2015.
3. Arshdeep Bagha & Vijay Madisetti, Internet of Things Ã¢?? A Hands-On Approach,VPT, 2014.
4. R G. Moreira, T.P Coultate Automatic Control for Food Processing System. 2001.
5. Willard, H.H., L. L. Merrit, J. A. Dean and F. L. Seattle, Instrumental Methods of Analysis, CBS Publishing Co, New York,2010

15EI028 CHEMICAL PROCESS SYSTEMS 3 0 0 3

Course Objectives

- To introduce various chemical processes
- To model different non linear process in chemical industries
- To control the various process in chemical industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Interpret the fundamentals of chemical process engineering
2. Implement the material balances in simple systems involving chemical reactions
3. Interpret the fundamentals of fluid mechanics
4. Analyse the parameters to be measured in chemical processing system
5. Outline the applications of chemical processes such as distillation columns and reactors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1								1		1	2
2	2	1	2	1							2		1	2
3	2	1	1								1		1	2
4	2	1	3	2							2	1	3	2
5	1	1	1	1							2	1	2	2

UNIT I **9 Hours**

INTRODUCTION TO CHEMICAL PROCESS SYSTEM

Historical overview of Chemical Engineering: Concepts of unit operations - Unit processes, - More recent developments. Chemical Industry - scope - Features & characteristics - Flow sheets - Symbols for various operations

UNIT II **9 Hours**

MATERIAL BALANCES OF CHEMICAL SYSTEM

Material balances in simple systems involving physical changes and chemical reactions -Systems involving recycle - purge - Bypass - Combustion reactions - Forms of energy - Optimum utilization of energy - Energy balance calculations in simple systems. Introduction to Computer aided calculations - Steady state material and energy balances - Combustion reactions

UNIT III **9 Hours**

BASIC FLUID CONCEPTS

Dimensions and Units - Velocity and Stress Fields - Viscosity and surface tension - Non Newtonian viscosity - Dimensional Analysis (Buckingham PI theorem) - Types of flows - Methods of Analysis - Fluid Statics. Pipe flow ÃƒÂ¢?? Pumps - Agitation and Mixing - Compressors

UNIT IV **9 Hours**

UNIT IVCHEMICAL PARAMETER MEASUREMENTS

Review of conduction - Resistance concept - Extended surfaces - Lumped capacitance. Introduction to Convection - Natural and forced convection - Correlations - Radiation

UNIT V **9 Hours**

APPLICATIONS

Fundamental principles and classification of Distillations Ãƒ???Ãƒ??Ãƒ?Ã‚Â¢?? Heat exchangers Adsorption? Absorption Drying Ãƒ???Ãƒ??Ãƒ?Ã‚Â¢?? Extraction - Membrane Process - Energy and Mass Conservation in process systems and industries - Introduction to chemical reactors

Total: 45 Hours

Reference(s)

1. 1. G.T. Austin, R.N. Shreve, Chemical Process Industries, 5th ed., McGraw Hill, 1984
2. 2. W.L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, Sixth Edition, McGraw Hill, 2011.
3. 3. R. M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd ed., John Wiley, New York, 2012.
4. 4. L.B. Anderson and L.A. Wenzel, Introduction to Chemical Engineering, McGraw Hill, 1961
5. H.S. Fogler, Elements of Chemical Reaction Engineering, 4th Ed., Prentice-Hall, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					8					8			4											22
2	2					10				4					4										20
3		2					6				10														18
4	2						4				6				6										18
5	2						4			6				4									6		22
																								Total	100

Assessment Questions
Remember

1. Define Internet of Things.
2. List the applications of IoT.
3. Indicate the major functional blocks in IoT.
4. Identify the challenges of IoT deployment.
5. State the benefits of IoT.
6. Identify the technologies that are used in IoT.
7. How will you secure the data in IoT?
8. Define privacy.
9. Define WSN.
10. State the addressing schemes in embedded system.
11. Define SoC.
12. Identify the technical issues in IoT.
13. Define interoperability.
14. State the principle of cyber security.
15. Define Internet of Everything.
16. Define an embedded system.
17. Identify the components of embedded computing system.
18. Classify embedded systems.
19. Recognize the two conditions that should be considered in selecting a processor for an embedded system.
20. Difference between Von Neumann and Harvard architecture.
21. Define station Mode.
22. List the physical devices that are used in IoT.
23. List the characteristics of sensor.
24. Define API.
25. Identify the wireless communication protocols available in CC3200.
26. Define protocol and standards.
27. Indicate the ADC channels are available in CC3200 ARM Controller.
28. List the features of ARM Cortex- M4.
29. Define Baud rate and Serial Communication Interface.

Understand

1. Illustrate the functional blocks and its characteristics of IoT.
2. Explain the working of various elements of IoT.
3. Demonstrate the architectural models for IoT.
4. Explain the logical level and physical level design of IOT.
5. Summarize the enabling technologies and IoT deployment.

6. Identify the characteristics of embedded computing system.
7. Explain the serial and parallel communication protocols online protocols.
8. Illustrate the architecture of CC3200.
9. Explain the working of CC3200 SoC WiFi Controller with Cloud connectivity.
10. Illustrate the security mechanisms for IP-based IoT applications.

Apply

1. Predict the role of physical devices and endpoints in IoT.
2. Demonstrate the steps to connect CC3200 SoC WiFi Controller with Cloud connectivity.
3. Choose the peripherals supported for Arm Cortex- M4 in CC3200.
4. Predict the challenges in embedded computing system design.
5. Summarize the various wireless communication standards for IoT.
6. Predict the role of Beagle Bone Black processor in IoT applications.
7. Demonstrate any two applications of IoT in Industrial automation.
8. Explain the application of CC3200 in medical, energy, retail and logistics domains.
9. Assess the impacts of IoT in agriculture, health care, transportation.

Analyse

1. Compare the Internet of Things and Machine to Machine (M2M) connectivity.
2. Differentiate between IoT and WSN.
3. Justify the market needs for IoT.
4. Compare the IPv4 and IPv6.
5. Differentiate TCP/IP and UDP
6. Conclude the security challenges in the IP-based Internet of Things.

Create

1. Generate the IoT framework for home automation.
2. Design an IoT framework for smart cities.
3. Design an IoT framework for health and life style for a real-time situation.

15EI029 AIRCRAFT INSTRUMENTATION 3 0 0 3

Course Objectives

- To know various instruments used in aircraft
- To analyze the principle of an aircraft engine
- To design the various controller used in aircraft

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Identify the necessity of instrumentation in aircraft
2. Design controllers to control an aircraft in nonlinear position
3. Attribute an aircraft cable control system components
4. Interpret the working principle and classification of aircraft engines
5. Implement an aircraft system using desired components

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	2									2	3
2	3	2	2	1									1	2
3	1	2	1	1									1	3
4	3	1	1	2										1
5	3		1	1									2	2

UNIT I **10 Hours**

AIRCRAFT BASIC INSTRUMENTS

Pitot Static System and flight Instruments- Air Speed Indicator - Vertical Speed Indicator - Altimeter. Gyro Instruments - Attitude Indicator - Directional Gyro Indicator - Turn Coordinator - Turn and Slip Indicator - Engine Instruments - Tachometer - Engine Pressure Ratio Indicator - Cylinder head Temperature gauge - Manifold Pressure gauge - Exhaust Temperature Gauge - Fuel Flow Indicator. Control Indicators - Flap Position Indicator - Trim position Indicator

UNIT II **10 Hours**

AIRCRAFT OPERATION AND CONTROLS

Introduction of Single/Mono Control System and Dual Control System - Control Column and Joy Stick Operations as Single and Dual Controls - Flap Controls - Airbrake Controls - Spoiler Controls - Trim tab Control system - Thrust Reversal - Variable Pitch Propeller Control. Rudder paddle Operation as Single and Dual Control with Steering - Differential Brakes

UNIT III **9 Hours**

AIRCRAFT CABLE CONTROL SYSTEM COMPONENTS

Joy Stick - Control Column - Bushes and Bearings - Housings - Dowels - Cables - Pulleys - Cable Connectors - Turnbuckles - Push-Pull Rods - Push - Pull Cables - Rod Ends - Eye End - Knuckle Joints - Lock Nuts - Levers - Bell Crank - Control Horns - Servo Arms - Introduction and Application wise classifications of Actuators

UNIT IV **9 Hours**

AIRCRAFT ENGINES

Reciprocating Engine: Engine Components and Mechanisms - Operation of 2 stroke and 4 stroke engines - Classification and Types and applications - Turbine Engines: Principle of operation - Design and Classification - Components of Gas turbine engines - Thrust Augmentation methods - Thrust reversal and vectoring

UNIT V **7 Hours**

AIRCRAFT SYSTEMS AND COMPONENTS

Hydraulic Control System - Air Conditioning System - Cabin Pressurization System (Cockpit and Passenger Compartment) - Fuel System - Lubrication systems

Total: 45 Hours

Reference(s)

1. Nagahushan.S.Sudha.L.K, "Aircraft instrumentation and Systems", International publishing house Private limited, 2014.
2. Pallett E.H.J,"Aircraft Instruments- Principles and Applications", Pearson education, 2013
3. Paul Degobert, "Automobiles and pollution"-SAE International I SBN-1-56091-563-3,2014.

15EI030 OPTIMAL STATE ESTIMATION 3 0 0 3

Course Objectives

- To impart Knowledge and Skills
- To design and implement a Discrete Kalman Filter
- To design and implement Extended Kalman Filter, Iterated Extended Kalman Filter, and Second-order Extended Kalman filter
- To design and implement Derivative Free Kalman filter such as Unscented Kalman filter and its variants and Ensemble Kalman Filter
- To design and implement Particle Filter, Unscented Particle Filter

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Identify Kalman Filter for Linear systems
2. interpret variants of Derivative Based Kalman Filters such as Extended Kalman filter, Iterated Extended Kalman filter, Second order Extended Kalman Filter for non-linear systems
3. Design and Implement variants of Derivative free Kalman Filters such as Unscented Kalman filter, Spherical and Simplex transformations based Unscented Kalman filter
4. Apply variants of H-infinity filters.
5. Select various types of Particle filters for non-linear and non-Gaussian systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2	3				1		1		1	1
2	2	2	1	2	3				1		1		1	1
3	2	2	2	2	3				1		1		1	1
4	3	3	1	2	3				1		1		2	1
5	3	1	1	3	3				1		1		2	1

UNIT I **9 Hours**

INTRODUCTION TO STATE ESTIMATION AND KALMAN FILTER

Review of Matrix Algebra and Matrix Calculus and Probability Theory - Least Square Estimation - Review of state observers for Deterministic System- Derivation of the Discrete-time Kalman filter - Kalman filter properties.

UNIT II **10 Hours**

EXTENDED KALMAN FILTER

Linearized Kalman filter - Extended Kalman filter - The iterated Extended Kalman filter - The Second order Extended Kalman filter - Constrained Extended Kalman filter- Simultaneous State and Parameter Estimation using EKF.

UNIT III **9 Hours**

UNSCENTED KALMAN FILTER

Means and Covariance of non-linear transformations - Unscented transformation - Unscented Kalman filtering - General Unscented transformation - The simplex unscented transformation- Spherical Unscented transformation - Simultaneous State and Parameter Estimation using UKF Constrained Unscented Kalman filter.

UNIT IV **9 Hours**

THE H-INFINITY FILTER

The H- infinity filter - Introduction - Kalman filter Limitations - A game theory Approach to H- infinity filtering - Steady state H- infinity Filtering: Mixed Kalman - Robust Kalman - Constrained H- infinity filtering.

UNIT V **8 Hours**

ENSEMBLE KALMAN FILTER AND PARTICLE FILTER

Bayesian state Estimation - Ensemble Kalman filter-Introduction to Particle filtering - SIS - Implementation issues: - Sample Impoverishment - SIR - Particle filter with EKF as proposal - Unscented Particle filter.

FOR FURTHER READING

Stabilizing depth measurements using Kalman filter - Multimodel Ensemble Kalman Filter - Adaptive Unscented Kalman Filter for nonlinear control.

Total: 45 Hours

Reference(s)

1. Bruce P. Gibbs, "Advanced Kalman Filtering, Least-Squares and Modeling: A Practical Handbook", Wiley, 2011
2. Adrian Pizzinga, "Restricted Kalman Filtering Thoery, Methods and Application", Springer, 2012
3. Xiao-Heng Chang, "Takagi - Sugeno Fuzzy systems Non fragile H infinity filtering", Springer,2012

15GE001 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Able to gain Knowledge about entrepreneurship, motivation and business.
2. Able to develop small scale industries in different field.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	1			2	1	1	2	1	3	2		
2		2	1			2	1	1	2	1	3	2		

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractionation, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3							2	2			1		2			2		2		2		4		20
2		3					2			2		2		2		2			3			4			20
3			3			2					2				2			4		3			4		20
4				3			2			2			2			3		4						4	20
5		1		2				2		2		2			2				5			4			20
																								Total	100

Assessment Questions

Remember

1. What is entrepreneurship?
2. What are the factors that motivate people to go into business?
3. Define a small-scale industry
4. Who is an intrapreneur?
5. State functions of SISI
6. What is serial entrepreneur?
7. What is Technopreneurship?
8. What is reversal method?
9. What is brainstorming?
10. What do you mean by term business idea?
11. Mention any two schemes Indian government provides to the development of entrepreneurship
12. What is a project report?
13. What is project scheduling?
14. Mention any four techniques available for project scheduling.
15. What is contract act?
16. Define MOU.
17. Mention any five external sources of finance to an entrepreneur.
18. Classify the financial needs of an organization
19. Why is a motivational theory important for an entrepreneur?

Understand

1. Why is entrepreneurship important of growth of a nation?
2. Mention the essential quality required for someone to be an entrepreneur.
3. How is network analysis helpful to the development of an entrepreneur?
4. Mention the essential requirements for a virtual capital.
5. How under-capitalization affects an entrepreneur
6. Mention the causes of dissolution of a firm.
7. How important is the support of IDBI to an entrepreneur?
8. What are the salient features of New Small Enterprise Policy, 1991?
9. Why scheduling is very important for a production design?

Apply

1. If you want to become as an entrepreneur, what will be your idea?
2. Select any one of the creative idea generation method and suggest an innovation that you can implement in your business.
3. Write a short notes on various legal aspects that you have to consider to run you business.

4. How will you generate your capital and other financial supports?
5. In case of getting enough financial support, plan your business and plot the various stages using any of the tools or techniques

Create

1. Draft a sample project report for your business
2. Do a network analysis using PERT and CPM for your business plan.
3. Write a brief report to apply to a financial organization for seeking financial support to your business

15GE002 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promoting the product / services
- Handle the human resources and taxation
- Understand Government industrial policies / support provided and prepare a business plan

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Increase in awareness of the entrepreneurship Development for engineering decisions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	1			2	1	1	2	1	3	1		

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.htm

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	2			2	2					2	2				2				2	20
2	2									6					6							6			20
3		3				2					3			3					3		3			3	20
4			3				3			3					3		3		3				2		20
5			3				3					3			3						3	2		3	20
																								Total	100

Assessment Questions
Remember

1. Who are Fabian Entrepreneur?
2. Mention the three functions of NSIC?
3. Narrate the role of IDBI in the development of Entrepreneurship?
4. What are the stages in a Project Lifecycle?
5. Give the meaning of Feasibility Report
6. What is Motivating Training?
7. Who is a Small Scale Entrepreneur?
8. How to develop Rural Entrepreneur?
9. What are the Social Problems of Women Entrepreneur?
10. What are the types of entrepreneurs?
11. List the various qualities of entrepreneur.
12. What is entrepreneurship training?
13. State the role of NISIET.
14. List the challenges and opportunities available in SSI's?

Understand

1. What are the elements of EDP?
2. How would you Classify Projects?
3. What is the role played by commercial banks in the development of entrepreneur?
4. What are the target groups of EDP?
5. What are the major problems faced by Small Entrepreneur?
6. What are the problems & prospects for women entrepreneur in India?

Apply

1. Describe the various functions performed by Entrepreneurs?
2. Explain the role of different agencies in the development of Entrepreneur?
3. Discuss the criteria for selecting a particular project?
4. Describe the role of Entrepreneur in the Development of Country?
5. Define business idea. Elaborate the problems and opportunities for an entrepreneur.
6. Elaborate the schemes offered by commercial banks for development of entrepreneurship.
7. Explain the significant role played by DIC & SISI for the development of entrepreneurship.

Analyse

1. Differentiate between entrepreneur and entrepreneurship
2. What are the problems of Women entrepreneurs and discuss the ways to overcome these barriers?
3. Discuss the importance of small scale industries in India

Evaluate

1. Review the entrepreneurial growth by the communities of south India.
2. Critically examine the growth and development of ancillarisation in India.

Create

1. Design a short entrepreneurship development programme for farmer.
2. "All economy is the effect for which entrepreneurship is the cause"-Discuss.
3. Discuss the various sources and collection of credit information of entrepreneurs

4. Discuss the role of the government both at the Central and State level in motivating and developing entrepreneurship in India.
5. Briefly explain the recommendation and policy implication for survival of SME's.
6. Developing countries like India need imitative entrepreneurs rather than innovative entrepreneurs". Do you agree? Justify your answer with examples.
7. Discuss the "Culture of Entrepreneurship" and its role in economic development of a nation. What factors contribute to nurturing such a culture?

15GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Understand the fundamentals of physics of nanomaterials
- Correlate on multidisciplinary branch
- Acquire the knowledge in nanomaterials synthesis, compile and analyze data and draw conclusions at nano level

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits

Course Outcomes (COs)

1. Classify the size dependant properties of different nanomaterials
2. Explain different experimental methods used for the preparation of nanomaterials
3. Analyse the data using different characterization techniques
4. Illustrate the different techniques to synthesize semiconductor nanostructures and utilize them for application
5. Identify the impact of nanomaterials and their applications in Nano devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	3	1											2	
3	3	2											2	
4	3	2											2	
5	3	1											2	

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures,nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - magnetic properties of nanoscale materials -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - chemical vapour deposition, plasma enhanced CVD, colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization - DC sputtering and RF sputtering process.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials.

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LEDÃƒÂ¢??s - basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- nano motors -bio nano particles-nano - objects - applications of nano materials in biological field.

FOR FURTHER READING

Application of graphene in various field - supercapacitors - third generation solar cell-dye sensitized solar cell (DSSC) -fuel cells.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007.
3. Guozhong Cao, Y. Wang, Nanostructures and Nanomaterials-Synthesis, Properties & Applications, Imperials College Press, 2011.

4. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw - Hill Education (India) Ltd, 2012.
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, Fuel cells: Principles and Applications, University Press, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	4	4		2					4				3					4						24
2	2	3	4		4	4				3				4											24
3	2	4	2			2	2				2			2											16
4		2			2	4				2				4					3						17
5	2	4				3	2				4				4										19
																								Total	100

Assessment Questions

Remember

1. Explain the term nano
2. List three types of classifications of nanomaterials.
3. Recall the principle behind lithography.
4. Define top-down and bottom-up approach.
5. Name two types of nanoarchitecture
6. Define nanocomposites.
7. Recall the principle of electron microscopy.
8. List 5 characterization techniques in nanotechnology.
9. Define quantum well and quantum wire.
10. Write the allotropy of carbon.

Understand

1. Explain the effect of nanometer length scale.
2. Can affect the system total energy when particle size reduced? Justify.
3. Explain plasma enhanced CVD.
4. Identify the difference between self-assembly and self-organization.
5. Name 3 synthesis process under bottom-up approach.
6. Explain contact mode in AFM.
7. Is it possible to explain the entire details of the sample by taking one characterization technique? if no, justify.

Apply

1. Find three day to day live commercial application of nanotechnology?
2. Choose two template methods used to obtain nanowire or nanorods.
3. Construct the experimental setup for organic LED.
4. Find 4 industrial applications of CNT.

Analyse

1. Differentiate between bulk and nanomaterials.

2. Identify the roll of nanoparticles in biological field.
3. Distinguish between glow discharge and RF sputtering.
4. Criticize the future challenges for nanotechnology?

Evaluate

1. Nanomaterials, do they exist in nature? If yes, Identify the nanomaterials and recognize.

15GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Exemplify the drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the electric field and space charge width of PN junction under different biasing
3. Explain the charge flow, temperature effects, turn on and turn off transients in PN junction diode
4. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations.
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2	2	1												
3	2	1												
4	2	1												
5														

UNIT I **9 Hours**

CARRIER TRANSPORT IN SEMICONDUCTORS

Carrier drift - drift current density - mobility effects on carrier density - conductivity in semiconductor - carrier transport by diffusion - diffusion current density - total current density - breakdown phenomena - avalanche breakdown.

UNIT II **9 Hours**

PHYSICS OF P-N JUNCTION

Basic structure-Built in potential barrier, Electric field and space charge width of P-N junction under zero, forward and reverse bias- Diffusion capacitance - one sided and linearly graded junctions.

UNIT III **9 Hours**

P-N JUNCTION DIODE

Qualitative description of charge flow in p-n junction - boundary condition - minority carrier distribution - ideal p-n junction current - temperature effects - applications - the turn on transient and turn off transient.

UNIT IV **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

Introduction to basic principle of operation - the modes of operation - amplification - minority carrier distribution in forward active mode - non-ideal effects - base with modulation - high injection emitter band gap narrowing - current clouding - breakdown voltage - voltage in open emitter configuration and open base configuration.

UNIT V **9 Hours**

OPTO ELECTRONIC DEVICES

Optical absorption in a semiconductor, photon absorption coefficient - electron hole pair generation - solar cell - homo junction and hetero junction - Photo transistor - laser diode, the optical cavity, optical absorption, loss and gain - threshold current.

FOR FURTHER READING

Organic semiconductors- diodes - transistors-working and applications

Total: 45 Hours

Reference(s)

1. Donald A Neamen, Semiconductor Physics and Devices, Tata McGraw Hill, 2012.
2. S. M. Sze and M. K. Lee, Semiconductor Devices, Physics and Technology, John-Wiley & Sons, 2015.
3. Ben. G. Streetman and S. K. Banerjee , Solid State Electronic Devices, Pearson Education Ltd, 2015.
4. C. Kittel, Introduction to Solid State Physics, John-Wiley & Sons, 2012.
5. J. Millman and C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill, 2010.
6. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley-VCH, 2006.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	3	4	4		2					2				3					2						20
2	2	3	4		4	4				3				4											24
3	2	4	2		2	2					4			4											20
4		2			2	4				2				4					4						18
5	2	4				2	2				4				4										18
																								Total	100

Assessment Questions

Remember

1. Define drift current density
2. Recall diffusion capacitance
3. Write the ideal diode equation
4. List the three modes of transistor operation
5. State the principle of solar cell

Understand

1. Identify the two scattering mechanisms that affect mobility of charge carriers in semiconductors
2. Sketch the energy band diagram of a P-N junction under thermal equilibrium
3. Exemplify the boundary conditions used to calculate minority carrier distribution in a junction diode
4. Explain the base width modulation occur in transistors
5. Illustrate the working mechanism of a phototransistor

Apply

1. By applying the concept of scattering, explain the mobility of holes in a semiconductor.
2. Apply Poission equation to space charge region and hence derive the electric field under zero bias
3. Show that the minority carrier concentrations in a diode decay exponentially with distance away from the junction to their thermal-equilibrium values.
4. Derive an expression for excess minority current in the emitter region under forward action mode by applying the ambipolar transport equation.
5. Show that the minority carrier concentrations in a diode decay exponentially with distance away from the junction to their thermal-equilibrium values.

Analyse

1. Differentiate drift current and diffusion current
2. Space charge width increases upon reverse bias. Justify
3. Silicon is preferred over germanium for the manufacture of semiconductor devices. Justify
4. Compare emitter bandgap narrowing and current crowding.
5. Differentiate homojunction and heterojunction laser

15GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - Einstein's prediction - spontaneous emission - stimulated emission - Einstein's relations - A and B coefficients - population inversion - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification. Components of lasers: active medium - pumping - pumping mechanisms - resonant cavity.

UNIT II **9 Hours**

CHARACTERISTICS AND TYPES OF LASERS

Introduction - directionality - intensity - coherence - monochromaticity. Classification of lasers - principle, construction, working, energy level diagram and applications of CO2 laser - dye laser - excimer laser - Nd:YAG laser - semiconductor laser.

UNIT III **9 Hours**

LASERS IN SCIENCE

Harmonic generation - stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - LIGO - rotation of the earth - measurement of distance - velocity measurement - holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Eye laser surgery - LASIK - photocoagulations - light induced biological hazards: Eye and skin - homeostasis - dentistry - laser angioplasty - laser endoscopy - different laser therapies.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting. Laser tracking: LIDAR. Lasers in electronics industry: ranging - information storage - bar code scanner. Lasers in defence: laser based military weapons - laser walls.

FOR FURTHER READING

Q-switching - mode locking - thermo-optic effects - astronomy lasers - fighting crime with lasers - laser engraving.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015.
2. M. N. Avadhanulu, An Introduction to Lasers Theory and Applications, S. Chand Publisher, 2013.
3. W. Koechner, M. Bass, Solid State Lasers: a graduate text, Springer Verlag, New York, 2006.
4. K. P. R. Nair, Atoms, Molecules and Lasers, Narosa Publishing House, 2009.
5. K. R. Nambiar, Lasers: Principles Types and Applications, New Age International Publications, 2006.
6. A. Sennaroglu, Solid-State Lasers and Applications, CRC Press, 2006.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	2	1		2	3	1			2			1	2							20
2	2	2			3	2	2		2	2			1	1			1		2						20
3	3				2	2	1		2		3		2	1	1			1	2						20
4	2	2			2	1	1		2	2	1		2	2	1			1	1						20
5	2	1			1		3		2		2		2	1			1	2	3						20
																								Total	100

Assessment Questions

Remember

1. Recognise the term LASER
2. Define stimulated absorption
3. Define spontaneous emission
4. Define stimulated emission
5. Distinguish between spontaneous and stimulated emission
6. State population inversion
7. List the four characteristics of lasers
8. Mention the five medical applications of lasers
9. State the principle behind the holography
10. Recall the term resonant cavity

Understand

1. Identify the condition needed for laser action
2. Interpret the pumping of atoms
3. Exemplify the optical excitation occurs in three level laser systems
4. Explain the determination of rotation of earth using laser
5. Summarize the application of lasers in welding and cutting
6. Explain the term LASIK
7. Classify the different types of lasers based on materials
8. Illustrate the working of laser in material processing

Apply

1. Predict the condition for laser action
2. Derive the Einstein's A and B coefficients
3. Deduce the expression for large stimulated emission
4. Construct the experimental setup for distance measurement
5. Find the applications of lasers in stimulated Raman
6. Assess the wavelength of emission of GaAs semiconductor laser whose bandgap energy is 1.44 eV.

Analyse

1. Laser beam should be monochromatic, Justify?
2. Differentiate ordinary light source from laser source
3. Compare the working of gas lasers with excimer laser
4. Four level laser systems are more efficient than three level laser systems. Justiify**?**

Evaluate

1. Determine the intensity of laser beam be focused on an area equal to the square of its wavelength. For He-Ne laser wavelength is 6328 A^0 and radiates energy at the rate of 1mW.
2. Choose the appropriate lasers for the materials processing in industry

15GE0C1 CORROSION SCIENCE 3 0 0 3

Course Objectives

- Recognize the terminologies used in corrosion science.
- Impart knowledge about the various types of corrosion and its mechanism.
- Understand the various methods of corrosion control, corrosion testing and monitoring.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. evaluate if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. calculate the rate of corrosion on metals using electrochemical methods of testing
5. propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	1	3												
4	2	2												
5	3	3												

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - passivation - direct and indirect damage by corrosion - importance of corrosion prevention in industries - area relationship in both active and passive states of metals - Pilling Bedworth ratio and its significance - units of corrosion rate (mdd and mpy) - importance of pitting factor - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages.

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion. High temperature oxidation, kinetics of protective film formation and catastrophic oxidation corrosion.

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - cracking - corrosion fatigue - filliform corrosion - fretting damage and microbes induced corrosion - corrosion mechanism on steel, iron, zinc and copper metal surfaces - thick layer and thin layer scale formation - in situ corrosion scale analysis.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: factors affecting corrosion - electrochemical methods of polarization - Tafel extrapolation polarization, linear polarization, impedance techniques - weight loss method - susceptibility test - testing for intergranular susceptibility and stress corrosion. Visual testing - liquid penetrant testing - magnetic particle testing - eddy current testing.

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection. Stray current corrosion problems and its prevention. Protective coatings: anodic and cathodic coatings - metal coatings: hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of sacrificial anode for corrosion control.

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems.

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, Introduction to Corrosion Engineering, CreateSpace Independent Publishing Platform, 2016.

2. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.

3. R. Winstone Revie and Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Science, 2008.

4. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, Singapore, 2008.

5. David E.J. Talbot (Author), James D.R. Talbot, Corrosion Science and Technology, Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.

6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	2	2		1	2	1		1	1	1		1	1	2		2	1			1				20
2	1	3			2	1	1			2			1	2			1	1					1		16
3	2	1			1	4	1			3				2			2	2				2			20
4	1	1	1		2	3	1		2	2	1		2	1	1		1	2					1		22
5	1	2			1	2			2	3			2	3			1	2			1	2			22
																								Total	100

Assessment Questions
Remember

1. Define Corrosion
2. Mention the five types of corrosion
3. Define dry corrosion. Explain the mechanism.
4. What are corrosion inhibitors? Give two examples.
5. What are corrosion inhibitors? Give two examples.
6. Write the working principle of Tafel polarization techniques.
7. How polarization and impedance techniques are used to measure the corrosion products?
8. Define cathodic protection.
9. ellaborate non-electrochemical and electrochemical methods of corrosion testing and monitoring.
10. What is Tafel linear polarization?
11. What is Tafel linear polarization?
12. In corrosion, which criteria involves nature of the metal
    a. Temperature
    b. Humidity
    c. pH
    d. Purity of the metal
13. An example of corrosion measurement technique is
    a. Tribometer
    b. non-destructive testing
    c. rupture testing

   d. Charpy test
14. In the weight loss method, the preferred duration of exposure of test samples to corrosive media is
    a. 10 days
    b. 1 month
    c. 1 year
    d. 1 day
15. The long term corrosion protection method is
    a. Impressed current method
    b. Proper choice of metal for the designing
    c. Cathode protection
    d. Sacrificial anode method
16. Indicate two purposes of corrosion testing.
17. Write the principal of anodic protection method.

Understand

1. Explain the mechanism of electrochemical corrosion.
2. Identify the relation between the two units used to measure corrosion rate.
3. Illustrate the Pourbaix digrams of Mg/Al/Fe and their limitations.
4. List the eight forms of corrosion. Explain each type with an example.
5. What are the factors influencing the corrosion rate? Explain.
6. Discuss the Pilling-Bedworth rule.
7. Differentiate between electrochemical and dry corrosion.
8. How inhibitors are used to protect the corrosion rate of the metal? Explain.
9. What are consequences of Pilling-Bedworth ratio?
10. List the difference between filliform corrosion and pitting corrosion.
11. By which method can we prevent corrosion in ship hulls?
    a. Sacrificial anode method
    b. Impressed current method
    c. Deaeration method
    d. Deactivation method
12. In order to form a protective oxide layer, the ratio of the volume of oxide formed to that of metal consumed should be
    a. greater than one
    b. less than one
    c. much greater than one
    d. none of the above
13. Stress corrosion is often observed in
    a. Welding
    b. Boilers
    c. Alloys
    d. Quenching of metals
14. A very dangerous form of corrosion which is difficult to monitor is
    a. Galvanic
    b. Pitting
    c. Crevice
    d. Stress
15. The method to overcome the disadvantages of Tafel plot is
    a. Weight loss method
    b. linear polarization
    c. organic coating

   d. non-destructive test
16. In sacrificial anodic protection
   a. an artificial cathode is connected to the metal to be protected
   b. an anodic metal is coated on the surface of the metal to be protected
   c. protection of the metal given by galvanizing the metal
   d. an artificial anode is connected to the metal to be protected
17. …………..is mostly used in sacrificial anode method.
   a. Zinc
   b. Magnesium
   c. Copper
   d. Platinum
18. Corrosion can be prevented by
   a. Alloying
   b. Tinning
   c. Galvanizing
   d. all of above
19. Which of following metals could provide cathodic protection to Fe?
   a. Al & Cu
   b. Al & Zn
   c. Zn & Cu
   d. Al & Ni
20. Galvanization is
   a. coating Zn on steel
   b. coating steel on steel
   c. coating SiC on steel
   d. coating rubber on steel
21. What is Tafel equation? Mention its application.
22. How is corrosion minimized by proper designing of equipment?
23. Mention the three visual corrosion testing methods.
24. Indicate the principles of cathodic protection.
25. Describe sacrificial anode with two examples.
26. What is a sacrificial anode? How does it protect a submerged pipeline?
27. Discuss the susceptibility tests for intergranular corrosion.

Apply

1. Area relationship between the anodic and cathodic part in galvanic corrosion. Discuss.
2. Describe alternatives to protective coatings.
3. How Tafel polarization and impedance techniques used to measure the corrosion products?
4. Name any two polarization methods for corrosion testing and monitoring.
5. Mention any two applications of susceptibility test.
6. Differentiate corrosion measurement from corrosion monitoring
7. Define cathodic protection? Under what conditions is this protection more useful?
8. Illustrate Tafel extrapolation polarization for the determination of corrosion rate.
9. Illustrate Tafel extrapolation polarization for the determination of corrosion rate.
10. Illustrate Tafel extrapolation polarization for the determination of corrosion rate.
11. Discuss the determination of corrosion rate by weight loss method.
12. Explain the control of corrosion by the use of sacrificial anodes and by impressed current cathodic protection.

Analyse

1. Explain why corrosion rate of metal is faster in aqueous solution than atmosphere air?
2. Why pitting corrosion is localized corrosion? Explain.
3. Compare the effects of corrosion products.
4. Identify different forms of corrosion in the metal surface.
5. What are the major implications of enhanced techniques of corrosion product analysis?
6.
    1. When zinc is coupled to steel and corrosion is tested in various environments, which one of the following happens?
    b. The corrosion rate of steel increases while that of zinc is decreased
    c. The corrosion rate of zinc is increased while that of steel is decreased
    d. The corrosion rates of both decrease
    e. The corrosion rates of both increase
6. Which corrosion control technique is most suitable inthe case of buried iron pipelines?
    g. Sacrificial anodic method
    h. Impressed current cathodic protection
    i. Electroplating
    j. Cathodic inhibitors
7. Outline the draw backs of cathodic protection?
8. For what purpose Mg bars are used in ships?
9. List any four corrosion inhibitors.
10. Discuss the importance of design and material selection in controlling corrosion.
11. Differentiate sacrificial anodic protection from impression current method.
12. Analyze the role of sacrificial anode method in the prevention of corrosion.
13. Explain how corrosion of metals controlled by sacrificial anode technique.
14. Compare sacrificial anode method and impressed current method.
15. List and explain the 6 design rules that should be followed to prevent corrosion.

15GE0C2 ENERGY STORING DEVICES AND FUEL CELLS **3 0 0 3**

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles.
- Identify the types of fuel cells and to relate the factors of energy and environment.
- Analyze various energy storage devices and fuel cells.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Analyze the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Identify different methods for the production of hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3												
3	3	1		1										
4	2	2												
5	3	3		1										

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of practical batteries - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries- zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells.

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - biomass pyrolysis -gas clean up - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy - life cycle assessment of fuel cell systems. Solar Cells: energy conversion devices, photovoltaic and photoelectrochemical cells - photobiochemical conversion cell.

FOR FURTHER READING

Energy conservation, Over utilization, Energy demanding activities.

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009.
2. F. Barbir,PEM fuel cells: Theory and practice,Elsevier, Burlington, MA, Academic Press, 2013.
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001.
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012.
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016.
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			1	2	2			1			1	3				1							15
2	4	1			4	5	2			2			1	2				1							22
3	3				4	6	2		1	3			1	1				1							22
4	1	2			4	4	1			4			2	4											22
5	2	2			2	5				3			2	3											19
																								Total	100

Assessment Questions

Remember

1. How galvanic cell is differing from electrolytic cell?
2. How is the potential of an electrochemical cell calculated?
3. List any four characteristics of primary batteries.
4. Mention any two characteristics and applications of zinc-carbon battery.
5. Recognize any two applications and characteristics of primary magnesium batteries.
6. Identify the applications and characteristics of Zn/HgO primary batteries.
7. Indicate any two applications of Zn/alkaline/MnO_2 battery.
8. Mentioned any two applications of Zn/Ag_2O primary battery.
9. Define capacity of a cell
10. Define discharge rate of a battery.
11. Describe the construction, cell reaction and applications of zinc-carbon battery.
12. Explain the construction, chemistry, advantages and uses of mercuric oxide battery.

13. Explain the major components and reaction of direct methanol fuel cell. List two applications.
14. Explain the working principle, components and applications of alkaline fuel cells
15. Discus the conversion of sunlight into electrical power in photoelectrochemical cells.

Understand

1. Mention the five different types of energy storage devices
2. Define the term battery
3. List any two differences between battery and cell.
4. Mention the three major components of cell.
5. Classify the batteries based on their cell reversibility.
6. Define cycle Life of a cell.
7. Explain the construction, cell reaction and applications of silver oxide batteries.
8. With a neat sketch explain the construction and working of phosphoric acid fuel cell.
9. Explain the major components and reactions of direct methanol fuel cell
10. Explain the production of hydrogen photobiochemical conversion cell.

Apply

1. Specific gravity is an indicator of charge in lead acid battery – Justify.
2. Illustrate the process of water electrolysis for the production of hydrogen.
3. How is the potential of an electrochemical cell calculated?
4. How is the potential of an electrochemical cell calculated?

Analyse

1. In the mid-winter car battery is not working –reason out.
2. Discuss the hydrogen energy strategies for sustainable development.
3. How galvanic cell is differing from electrolytic cell?
4. How batteries are rated?
5. Differentiate between primary and secondary batteries.

15GE0C3 POLYMER CHEMISTRY AND PROCESSING

3 0 0 3

Course Objectives

- Impart knowledge on the basic concepts of polymers and its mechanism
- Use the appropriate polymerization techniques to synthesize the polymers and its processing
- Select the suitable polymers for various applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical polymerization - cationic, anionic and co-ordination (Ziegler-Natta) polymerization, copolymerization, condensation polymerization (nylon-6,6) ring opening polymerization (nylon-6). Elastomers: Natural rubber - vulcanization - synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone(PEEK), polysulphones, polyimides.

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation.

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties by TGA and DSC, Testing tensile strength, Izod impact, Compressive strength, Rockwell hardness, Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption.

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plactics fabrication: hand-layup - filament winding and pultrusion.

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration.

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International (P) Ltd., New Delhi, 2015.
2. Joel R. Fried, Polymer Science and Technology, Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, Polymer Analysis, John Wiley & Sons, New York, 2008
5. George Odian , Principles of Polymerization, John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, Introduction to Polymers, CRC Press, New York, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	3		2	2	3		2	2	3		1	1	1										22
2	1	1	4		1	1	3		1	1	3		1	1											18
3	1	1	1		1	1			1	2	2			2			1	1	4						18
4	1				1	2	2		3	2	2		2	2	1								2		20
5	1	1	1		2	2	1		2	2	3		2	2	3										22
																								Total	100

Assessment Questions

Remember

1. Recall two factors that govern termination of cationic polymerization.
2. Identify the monomers used in styrene -butadiene rubber.
3. Give an examples for the thermosetting and thermoplastic polymers.
4. What is copolymerization? Give an example
5. Name two synthetic polymers which are used for making textile fibres.
6. Define the role of Ziegler – Natta catalysts
7. List the examples of Ziegler – Natta catalysts.

8. Identify the four types of polymerization technique.
9. List any two disadvantages of suspension polymerization.
10. Point out the advantages of bulk polymerization technique.
11. Why does natural rubber need compounding?
12. List any four applications of injection moulding process.
13. List the various additives in processing of plastics.
14. List the two properties of heat resistant polymers .
15. Mention the application of flame retardant polymers.

Understand

1. Classify the polymers based on source
2. Discuss the addition and chain growth polymerization with example
3. Compare addition and condensation polymerization reaction with example for each type .
4. Explain homogeneous and heterogeneous polymerization.
5. Explain the mechanism involved in addition polymerization of vinylChloride
6. Explain the condensation polymerization method taking nylon 6,6,nylon synthesis as a representative example.
7. Discuss the preparation method and any three properties of Polysulphone.
8. Summaries the salient features, advantages and disadvantages of bulk and emulsion polymerization techniques.
9. Compare the homogeneous and heterogeneous polymerization method.
10. With a neat sketch, discuss the functioning of melt, dry and wet spinning process.
11. Illustrate the compression and extrusion moulding of plastics with diagram neat diagram.
12. Explain the coordination polymerization mechanism using a sutable example.

Apply

1. Relate the various steps involved in anionic and cationic polymerisation using suitable examples.
2. Select the suitable polymerization techniques for synthesis of PMMA and SBR
3. Assess the characterisation techniques used to find the structure of polymer .
4. Find the method to process the composite materials with example.
5. Execute the filament – winding Technique for manufacturing of rocket motor bodies.

Analyse

1. Distinguish between addition and condensation polymerisation.
2. Natural rubber need vulcanization –Justify.
3. Compare the salient features, advantages and disadvantages of solution and suspension polymerization techniques.
4. Bring out the differences between thermoforming and vacuum-forming process.
5. Outline the applications of polymer in controlled drug delivery and artificial organs.

Evaluate

1. Judge the biomedical applications of polymers in Hemo dialysis and hemo filtration.
2. Choose the suitable moulding Technique for polyvinyl chloride.

15EI0YA BIO-MEDICAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To Understand the role of instrumentation in bio medical engineering field
- To get ample knowledge on Electro-physiological and non-electric parameter measurement
- To Understand principles of medical imaging - CT, MRI

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Analyze the human physiology and characterize the different transducers to measure its parameters
2. Classify the various Electro physiological and blood flow measurements
3. Examine the techniques for heart and blood pressure measurements
4. Construct the techniques used in medical image analysis
5. Choose the appropriate assistive and therapeutic devices for illness

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1	1								-	-
2	2	1	2	3	1								-	-
3	2	1	3	3	2									-
4	2	2	3	2	2	1								-
5	2	3	3	2	3	1							-	-

UNIT I **10 Hours**

HUMAN PHYSIOLOGY AND BIO POTENTIAL ELECTRODES

Cell and their structures - action and resting potential - nervous system: functional organisation of the nervous system, structure of nervous system, neurons, synapse -transmitters and neural communication - cardiovascular system- Physiology of heart and lungs - Circulation and respiration - Transducers - Different types - Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers - Selection criteria

UNIT II **9 Hours**

ELECTRO-PHYSIOLOGICAL AND BLOOD FLOW MEASUREMENT

Basic components of a biomedical system - Electrodes - Micro, needle and surface electrodes - Amplifiers - Preamplifiers, differential amplifiers, chopper amplifiers - Isolation amplifier. ECG - EEG - Lead systems and recording methods - Typical waveforms

UNIT III **9 Hours**

NON - ELECTRICAL PARAMETER MEASUREMENT

Measurement of blood pressure - Sphygmomanometer and cardiac catheterization - Heart rate- Heart sound –Body Plethysmography -pH of blood - pulse oximeter

UNIT IV **9 Hours**

MEDICAL IMAGING PARAMETER MEASUREMENTS

X- RAY machine - Computer Tomography - Magnetic Resonance Imaging system - ultra sonography - Endoscopy - bio-telemetry.

UNIT V **8 Hours**

ASSISTING AND THERAPEUTIC DEVICES

Cardiac pacemakers - defibrillators - ventilators- heart lung machine - dialysers - elements of audio and visual aids

FOR FURTHER READING

Biosensors - glucose and drug detection, biomechanics - limb prosthetics - orthotics

Total: 45 Hours

Reference(s)

1. R.S.Khandpur, Hand Book of Bio-Medical instrumentation, Tata McGraw Hill publishing company Ltd., 2014
2. J.G. Webster, Medical Instrumentation: Application and Design, John Wiley and Sons, New York, 2010
3. Leslie Cromwell, Biomedical Instrumentation and measurement, Tata McGraw Hill, 2007
4. G. Well, Biomedical Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2011

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	4				4				5								5							20
2		4				4				6				6											20
3	2	2				4				6				6											20
4		2				4				6												8			20
5	2	4				6			2	6															20
																								Total	100

Assessment Questions

Remember

1. Recall the principle ions responsible for action potential.
2. State the principle fluid medium in cell.
3. Define depolarization of a cell
4. Recall the instrument that is used to find epilepsy.
5. List the ranges of frequency and voltage related to EEG
6. List the lead configurations used in ECG
7. List out the important parts of an ECG recorder.
8. List the characteristics of ECG preamplifier.

Understand

1. Explain the depolarization and repolarization of heart muscle with reference to ECG wave form
2. Summarize the cardio pulmonary blood circulation system
3. Explain the origin of different heart sounds
4. Summarize the characteristics of resting potential and action potential in the cell
5. Explain the principle of a Computer Tomography system with a schematic sketch.
6. Illustrate the operation of ultrasonic imaging systems.
7. Explain the working of X-ray machine.
8. Abstract the principle and working of electromagnetic blood flow meters.
9. Explain the analysis of EEG signal.
10. Illustrate 10-20 electrode systems used in EEG with a schematic sketch.
11. Illustrate two types of audio aids with diagram
12. Illustrate a heart lung machine with a schematic sketch.

Apply

1. Construct with a schematic sketch an EEG measuring system
2. Demostrate how many electrodes are required to be attached to a human subject for recording any one of the unipolar chest lead signals? In the standard 12-lead ECG recording system.
3. Find the differences in the function of ventricular asynchronous pacemaker and ventricular synchronous pacemaker.
4. Implement the M mode for the ultrasonic imaging system with a suitable diagram.
5. Execute the working of an 12 lead ECG machine with a neat block diagram
6. Asses the working of the ultrasonic imaging system (M-mode) with a suitable diagram.
7. Compute the function of ventricular asynchronous pacemaker and ventricular synchronous pacemaker.
8. Implement a biotelemetry with suitable applications with a neat sketch.
9. Find out the merits of medical thermography.

Analyse

1. Outline the different types of heart sounds for different condition with specific schematic wave forms.
2. Compare between metallic microelectrode and non-metallic microelectrode.
3. Differentiate the types of electrodes that are used to record EEG
4. Outline the medical name of low blood pressure
5. Justify: A certain patient monitoring unit has an input amplifier with a CMRR of 1, 00,000:1 at 60 Hz. At other frequencies, CMRR is 1000:1. Do you consider these ratios adequate for the monitoring the ECG?
6. Justify the essential use of a coupling medium like olive oil or special jelly are essential in ultrasonic imaging system?
7. Outline the various electro surgery techniques used in diathermy unit.
8. Conclude on what parameters does the free running frequency of VCO depend on?

Evaluate

1. Choose type of electrode the hydrogen ion concentration of the blood is easily determined?
2. Critiq the following statement: MRI is superior to other imaging systems
3. For perfect lock,Determine the phase relation between the incoming signal and VCO output signal?

Create

1. List the electrodes that have high input impedance.
2. Produce a biotelemetry system with necessary components with its schematic sketch.
3. Relate a CT imaging to a MRI scan. Justify the same with principles and diagrams

15EI0YB VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To provide an overview of Virtual instruments
- To bring out the overview of the software
- To know about the programming structure of the software
- To familiarize the student with the Applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Explain the basics of Virtual or graphical instrumentation concepts
2. Summarize the overview of G programming, labels, data types and debug the G programming
3. Select the appropriate structuring concept to be used in graphical programming
4. Formulate the procedure to install DAQ in various OS and its interfacing methods
5. Implement the IMAQ Motion control and machine vision concepts for industrial application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	1	2	1	1	1								1	1
3	1	3	3	2	3								2	2
4	1	3	2	3	3								2	3
5	1	3	3	3	3								2	3

UNIT I **9 Hours**

INTRODUCTION

General functional description of digital instrument - Block diagram of a Virtual Instrument - Advantages of Virtual Instruments over conventional instruments - Architecture of a Virtual Instrument and a its relation to the operating system. Advantages of Virtual Instruments over conventional instruments

UNIT II **10 Hours**

SOFTWARE OVERVIEW

VI - Graphical user interfaces - Controls and indicators - 'G' programming - Labels and Text - Shape, size and color - Owned and free labels -Data type, Format, Precision and representation - Data types - Data flow programming -Editing - Debugging and Running a Virtual Instrument - Graphical programming palettes and tools - Front panel objects - Data types

UNIT III **10 Hours**

PROGRAMMING STRUCTURE

FOR Loops, WHILE Loops, CASE Structure, Formula nodes, Sequence structures - Arrays and Clusters - Array Operations - Bundle - Bundle/Unbundle by name, graphs and charts - String and file I/O - High level and Low level file I/O's - Attribute modes Local and Global variables. Bundle/Unbundle by name

UNIT IV **7 Hours**

OPERATING SYSTEM AND HARDWARE ASPECTS

Current trends Operating system requirements - Data Acquisition Card(DAQ) : DAQ hardware, Grounding methods, Resolution, Analog I/O, Digital I/O - DAQ Software Architecture - Configuring the DAQ hardware/software for temperature measurement.

UNIT V **9 Hours**

APPLICATIONS

IMAQ Motion Control: components of a motion control system, configuration, prototyping and development - Interfacing Servomotor and Stepper motor in LabVIEW. Machine Vision: Edge Detection, Dimensional Measurements, Color Inspection, Optical Character Recognition.

FOR FURTHER READING

PCI bus : Architecture, function, configuring PCI bus in LabVIEW - GPIB : Architecture, function, configuring GPIB in LabVIEW - VISA communication.

Total: 45 Hours

Reference(s)

1. Garry M Johnson, Labview Graphical Programming, Tata McGraw Hill book Co, New Delhi, 2012
2. Jeffrey Travis and Jim Kring, LabVIEW for Everyone: Graphical Programming made Easy and Fun, Tata McGraw Hill book Co, New Delhi, 2011
3. LabVIEW: Basics I & II Manual, National Instruments, Bangalore, 2011
4. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2009.
5. Donald J. Sterling, Technicians Guide to Fiber Optics, Delmar publisher, 2009.
6. M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4					8	4							4											20
2						12			2	4															18
3	4	2			2	12	2																		22
4						10				10				2											22
5					2	8				8															18
																								Total	100

Assessment Questions

Remember

1. Define Virtual Instrumentation
2. State graphical system design.
3. List three main components of a virtual instrument
4. Define modular programming.
5. State Sub VI
6. List the different types of loops used in VI
7. State multidimensional array
8. Define auto-indexing
9. List out the different types of 3D graphs
10. Recall the basic difference between a waveform chart and a graph

Understand

1. Illustrate the virtual instrumentation model and graphical system design model in detail
2. Compare text-based programming and graphical programming
3. Explain the block diagram of a typical embedded system software and hardware design flow and compare with stream-lined development flow with graphical system design
4. Illustrate how to create, modify and debug VIs using floating tool palettes?
5. Explain the importance of the toolbar buttons that appear on the block diagram
6. Classify the difference between a shift register and a feedback node
7. Explain, how a stand-alone application be created?
8. Compare while loop with a For loop
9. Explain the methods of changing the value of an element in an existing cluster
10. Interpret the importance of the basic elements of a graph

Apply

1. Use two numeric inputs ad perform add, multiply, subtract and divide operation
2. Construct a program to divide two numbers and find the remainder and quotient
3. Design NOT, AND and OR gates using NAND gate and verify their truth table
4. Find the equivalent gray code for a given BCD.
5. Construct a sub VI to convert radians to degrees
6. Construct a program to find the sum of first 100 natural numbers
7. Show a VI that generates two 1D arrays and create another array which consists all the elements of the first two arrays
8. Execute a VI to generate a sine wave using Simulate Signal Express VI.
9. Use the Scan from string function to find a part of the string in the prescribed format. Also display the remaining string and offset after the scan
10. Use the IMAQ Wind Draw function to acquire a selected portion of the imageÂ

Analyse

1. Differentiate the portion of the string available before the match and after the match, and the offset of the string after the match
2. Justify that, it is advisable to use two event structures inside a loop?
3. Outline DAQ Software Architecture
4. Integrate the concept of interfacing Servomotor and Stepper motor in LabVIEW
5. Structure the Edge detection method in Labview programming using IMAQ tools

Evaluate

1. check whether the given number is odd or even.
2. Judge a VI that split an input string into two outputs with reference to a separating character and find the length of the input string and reverse the string
3. Check a program in VI that finds whether the given number is a prime number or not using (a) a For Loop and (b) a While Loop
4. Choose the match pattern function check whether the given expression is available in the input string
5. Check a VI to plot a circle in the XY graph using a For Loop

Create

1. Generate a 2D numeric array (5X5) containing random numbers and find it transpose
2. Relate a VI to produce four lines of digital outputs and to control the digital I/O lines on the DAQ device
3. Derive a VI which consists of a numeric array with even and odd elements and separate the odd and even elements in two different arrays

15EI0YC INSTRUMENTATION IN AEROSPACE AND NAVIGATION

3 0 0 3

Course Objectives

- To understand the concept of instruments used in the aircraft and aerospace.
- To analyze the different types of flight control system and navigation.
- To identify the sensor and controls used in satellite and space vehicle.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Explain the principles of measuring instruments and indicators for aircraft and aerospace Applications
2. Select an appropriate navigation system for a given problem
3. Analyze asuitable flight control scheme for a given situation.
4. Differentiate the working principle of instrumentation in satellite and space vehicle
5. Identify the appropriate aircraft engine instruments required for designing an aircraft.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1	2								-	-
2	1	2	3	1	3								-	-
3	1	3	2	3	2								-	-
4	2	3	1	3	1								-	-
5	2	2	3	1	3								-	-

UNIT I **9 Hours**

AIR CRAFT AND AEROSPACE VEHICLE INSTRUMENTATION

Basic T instruments - types of air speeds - Air data instruments: altimeter, air speed indicator, altitude indicator, Mach meter - gyroscopic instruments - turn and back indicator - artificial horizon - Electronic flight instrument unit - Accelerometers - sensors and actuators.

UNIT II **10 Hours**

RADIO NAVIGATION AIDS

Navigation and its types - Automatic direction finder - distance measuring equipments - non directional beacons - course deviation indicator - instruments landing system - microwave landing system - very high frequency omni directional range instrument - Tactical Air Navigation - radar basic terminology - primary and secondary surveillance radar.

UNIT III **8 Hours**

FLIGHT CONTROL SYSTEM

Principles of flight control, flight control surfaces, flight control linkage systems, Autopilot system , trim and feel, flight control actuation, fly by wire system, fly by light fcs, Airbus and Boeing implementations, interrelationship of flight control, guidance and vehicle management systems.

UNIT IV **9 Hours**

SATELLITE AND SPACE VEHICLE INSTRUMENTATION

Global Positioning System (GPS) - propulsion controls - propulsion unit - Sun sensors - Horizon sensors - star tracker - Stabilisation controls - GPS Aided GEO Augmented Navigation (GAGAN) and Indian Regional Navigation Satellite System (IRNSS) - Local Area Augmentation System (LASS), Wide Area Augmentation System (WAAS).

UNIT V **9 Hours**

AIR CRAFT FLIGHT SIMULATION INSTRUMENTATION

Basic description of a flight simulator - Solution of Aerodynamics equations - various types of aircraft engine instruments - Vibration measurements - Tachometers -Temperature gauges - Pressure gauges - Operation and Principles - Horizontal Situation Indicator - Simulation of autopilot system - Doppler and Inertial Navigation instruments

FOR FURTHER READING

Hydraulic systems troubles - landing gear troubles - cabin conditioning troubles - indication of unsafe canopy - Boeing condition - Radio troubles - Separate generator - System troubles - Trouble indicator light - Advantages of instrumentated flight - Black box and its use.

Total: 45 Hours

Reference(s)

1. John G. Webster and Halit Eren, "Measurement, Instrumentation, and Sensors Handbook", CRC Press, Taylor & Francis Group, New York, 2014.
2. Nagaraja N.S., "Elements of Electronic Navigation", Tata Mcgraw Hill Publishing Ltd., New Delhi, 2006.
3. Keyton.M and Walker.R, Fried,"Avionics navigation systems",John Wiley, 1997.
4. Pallett E.G.H., "Aircraft Instrumentation and Integrated Systems", Longman Scientific and Technical, 1992.
5. Ching-Fang Lin, "Modern guidance, navigation and control processing", Prentice hall, Englewood cliffs, New Jersy, 1991.
6. John.H. Blakelock, "Automatic control of aircraft and missiles", John wiley and sons.inc, 1991.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		2				2	12			4															20
2		2			2	16																			20
3		1			1	2			2	14															20
4					2					4				14											20
5					2					14				4											20
																								Total	100

Assessment Questions
Remember
1. State the most stable configuration of an airplane in roll.
2. Â Reproduce the flight instruments used on an aircraft to determine its attitude in flight.
3. Define frequency in radio terms.
4. List the three characteristics of Distance Measuring Equipments (DME).
5. List the four types of flight control systems
6. Define fly by wire system
7. Define Global Positioning System (GPS)
8. State the use of sun sensors in satellites
9. Define Flight simulator
10. List any two types of aircraft engine instruments.

Understand
1. Explain the principle of operation of Altimeter.
2. Explain the working of Distance Measuring Equipments (DME).
3. Classify the navigation system based on their functions.
4. Illustrate the air speed indicator with neat diagram
5. Identify the air data instruments
6. Interpret the imporatnce of flight control system
7. Explain the hydro mechanical flight control system with suitable diagram
8. Summarize the functioning of GPS Aided GEO Augmented Navigation (GAGAN).
9. Explain the uses of satellites involved in Indian Regional Navigation Satellite System (IRNSS)
10. Explain the principle and operation of Horizontal Situation Indicator.
11. Identify the applications of flight simulator

Apply
1. Show the uses of loop areial theory in ground direction finding station.
2. Find the factors affecting range and accuracy of ground direction finding station.
3. Show the construction and principle of working of altimeter
4. Find the application of flight instruments in aircraft
5. Show the control surfaces in primary flight control system
6. Find the applications of autopilot system in radio controlled models
7. Predict how the satellite is separated from the final stage of the launcher.
8. Assess the imporatnce of stabilization and attitude control in satellite
9. FindÂ the solution of Aerodynamics equations.
10. Show the four basic functions of GPS with neat diagram

Analyse

1. Compare the two types of modulation caharcteristics of non directional beacons
2. Outline the functions of non directional beacons
3. Compare the aircraft instruments systems based on their applications
4. Differenciate fly by wire and fly by light flight control systems
5. Outline the six steps which are required to use an autopilot function
6. Compare the three segments of GPS based on their functions
7. Differenciate Local Area Augmentation System (LASS) and Wide Area Augmentation System (WAAS).
8. Outline the uses of selective availability (S/A) in GPS
9. Compare any four basic schemes Inertial Navigation instruments

Evaluate

1. Criticise any five air speed limitations

Create

1. Generate an autopilot simulation system for landing an aircraft using controllers based on Model Free Adaptive (MFA) neural network architecture
2. Plan a navigation route for a Global Positioning System

15EI0YD OPTOELECTRONICS AND LASER INSTRUMENTATION

3 0 0 3

Course Objectives

- To acquire basic concepts of optical fibers and their properties
- To provide adequate knowledge about industrial applications of Lasers
- To understand the concept of holography and identify the medical applications of Lasers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Check the properties of optical fibers, their light sources and detectors.
2. Implement laser in a fiber-optic sensor for the measurement of various physical quantities.
3. Plan the application of laser in industries and holography.
4. Differentiate the use of laser instruments for various medical applications.
5. Attribute the characteristics of opto-electronic components for specific applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	1									
2	3	2	3	1	1									
3	2	1	3	2	1									
4	3	1	3	2	1									
5	2	1	1	1	3									

UNIT I **9 Hours**

OPTICAL FIBERS AND THEIR PROPERTIES

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors

UNIT II **10 Hours**

LASER FUNDAMENTALS AND FIBER OPTIC SENSORS

Laser configuration - Q-Switching - Mode locking - Different types of Lasers - Ruby, Neodymium - Doped Yttrium Aluminium Garnet (Nd-Yag), Helium-Neon (He-Ne), CO2, Argon ion - IR sources and detectors - Interferometer method of measurement of length - Moire fringes - Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope - Polarization maintaining fibers

UNIT III **9 Hours**

LASER INSTRUMENTATION

Industrial applications of lasers - Bio-medical application - Laser Doppler velocity meter - Laser heating - Holography: Principle, Methods, Holographic Interferometers and applications

UNIT IV **9 Hours**

MEDICAL APPLICATIONS

Lasers and tissue interaction - Laser instruments for surgery - Removal of tumours in vocal cords - Plastic surgery - Dermatology

UNIT V **8 Hours**

OPTO-ELECTRONIC COMPONENTS

Light Emitting Diode (LED) - Laser Diode - PIN Diode & Avalanche Photo Diode - Electro-optic - Magneto optic - Acousto-optic Modulators

FOR FURTHER READING

Applications of Laser in Medical Field

Total: 45 Hours

Reference(s)

1. Keiser G, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
2. Gupta, Fiber Optics Communication, Prentice Hall of India, 2010.
3. Ghatak A.K and Thiyagarajar K, Optical Electronics Foundation Book, Tata Mc Graw Hill, New Delhi, 2012.

4. Behrouza A Forouzan,Data Communications and Networking ,Fourth edition,McGraw Hill, 2007
5. Alessandri Ferrero and Vincenzo Piuri, A Simulation Tool for Virtual Laboratory Experiments in www environment, IEEE Transactions on IM, Vol. 48, 1999
6. Kang B. Lee and Richard D. Schneeman, Internet-based Distributed Measurement and Control Application, IEEE magazine IM, June 1999.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4			4	4																			16
2	2				2	4				6				2				2				2			20
3	2				2	4				6				2	3							2			21
4		2			2	6				6				2	3										21
5		2				6				6				6								2			22
																								Total	100

Assessment Questions

Remember

1. List out the major measurement instruments used in the fiber optic and optoelectronic fields.
2. List out the functional requirements of a LASER.
3. Define critical angle and numerical aperture as related to fibers.
4. List out the general areas where energy or information can be lost in a fiber optic data link.
5. Mention the advantages of LASER over LED.
6. Infer the principle used in the working of fibers as light guide.
7. Define holography.
8. Define hologram.
9. Recognize optoelectronic devices.
10. Define photodiode.

Understand

1. Describe the characteristics and importance of total internal reflection to fiber optics.
2. Explain the characteristics of LASER light.
3. Summarize and compute the major dB and power losses in a fiber optic communication system.
4. Explain the operation, characteristics and relative merits of major light emitter and detector types.
5. Draw and explain the different types of fiber splicing techniques.
6. Explain the material processing steps.
7. Draw and explain different configurations of optical fiber.
8. Explain the basic principle of electro-optic modulators.
9. Summarize the properties of photodiodes.

Apply

1. Estimate the number of photons emitted per second from a laser that puts out one watt of power and also state clearly the assumptions made.
2. Explain the applications of Holographic interferometry.
3. Find the core radius for a single mode fiber at an operating wavelength=1300nm with n (core) =1.505 and n(cladding)=1.502.
4. Find the cut-off wavelength for a SI fiber to exhibit SM operation when the core refractive index and radius are 1.46 and 4.5 µm respectively with the relative index difference being 0.25%.

5. Calculate the waveguide dispersion at 1320nm for single mode fiber with core and cladding of 9nm and125nm, n1=1.48 and n2=0.22.
6. Given silicon Avalanche Photo Diode has a quantum efficiency of 65% at a wavelength of 900nm.If 0.5 MW of optical power produces a multiplied photocurrent 10 µA, find the multiplication factor M.
7. Derive the expression for Signal to Noise Ratio of a photo detector.
8. Calculate the responsivity of a detector with quantum efficiency of 10% at 800 nm.
9. Calculate the transit time for a silicon photodiode of saturation velocity of 105ms-1 and of 5µm depletion layer thickness.
10. Two multimode step index fibers have Numerical Aperture of 0.2 and 0.4 respectively and both have the same core refractive index which is 1.48. Estimate the insertion loss at a joint in each fiber caused by a 50 angular misalignment of the fiber core axes. It may be assumed that the medium between the fibers in air.

Analyze / Evaluate

1. Identify and describe the major fiber optic data network systems.
2. Contrast and compare repeaters, regenerators and optical amplifiers.
3. Compare the advantages and disadvantages of each type of fiber for given applications.
4. Differentiate radiometric and photometric systems for measuring light.
5. Classify the optical fiber sensors.
6. A single mode fiber has beat length of 8 cm at 1300nm.Find the modal birefringence.
7. Differentiate between LED and LASER diode.
8. Why does the attenuation limit curve slope downwards to the right?
9. Differentiate index mode laser and guided mode laser.
10. The specifications of the light sources are converted to equivalent rise time in rise time budget. Why?
11. Bring out the importance of electro optic devices.
12. Describe electro-optic amplitude modulation with neat sketch.

Create

1. Predict the reaction of light rays to the following optical components: Mirrors, lenses, and prisms.
2. Determine the instruments which are used when taking fiber optic and optoelectronic measurements.
3. Calculate the power requirements of laser for material processing.
4. Compute the range of quantum efficiency of an InGa. As PIN diode in the wavelength range between 1200 nm and 1600 nm if the responsivity of the diode is specified to be more than 0.6 A/W in the required wavelength region. Use the necessary physical constants listed. Speed of light in vacuum =3 × 108 m/s, Electron charge =1.602 × 10-19, C Planck’s constant =6.6256 × 10-34 J-S, Boltzmann’s constant =1.38 × 10-23 J/K and Band gap energy of Gas = 1.15 eV at 300K
5. Estimate the losses encountered while coupling power from a source to a fiber due to mismatch in their numerical apertures and surface areas.

15EI0YE PROGRAMMABLE LOGIC CONTROLLERS 3 0 0 3

Course Objectives

- To impart knowledge about automation and architecture of PLC
- To understand the PLC programming using timers, counters and advanced PLC functions
- To familiarize the student with applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Explain the fundamentals Concepts of Automation
2. Summarize the architecture and interfacing techniques of PLC
3. Select the suitable PLC Programming languages
4. Attribute the various functions and instruction sets of PLC
5. Generate a suitable logical programming for given applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2	2		3						2	2
2	2	1		2	2		3						2	2
3	2	1		2	2		3						2	2
4	2	1		2	2		3						2	2
5	2	1		2	2		3						2	2

UNIT I **10 Hours**

INTRODUCTION TO AUTOMATION

Evolution of automation -Types of automation -Fixed, flexible and programmable automation - Batch process and continuous process - open loop system and closed loop system - Function of sensors - Proximity sensors: Capacitive and Inductive - Infrared and Laser - Actuators : Solenoid valve - servo motor.

UNIT II **9 Hours**

ARCHITECTURE OF PLC

Components of PLC - Processor - Memory: Types of memory, Memory Mapping - Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC

UNIT III **8 Hours**

PLC PROGRAMMING

Programming methods - Ladder logic - Function block diagram (FBD) - Structure text - Ladder logic components: Boolean logic using ladder logicprogramming-Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter

UNIT IV **10 Hours**

ADVANCED PLC FUNCTONS

Instructions in PLC: Program Control Instructions, Math Instructions, Data Manipulation Instructions: Data compare operations, Data transfer operations - Sequencer and Shift register instructions- Analog Instructions: PID Controller - Scaling Instructions

UNIT V **8 Hours**

APPLICATIONS OF PLC

Case Studies: Bottle filling system - Pick and place robot - Car Parking - Traffic light control (4 ways with pedestrian signal) -Elevators - Pneumatic stamping system

Total: 45 Hours

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India,2014.
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes/Elsevier, 2015
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.

15EI0YF SENSOR TECHNOLOGY 3 0 0 3

Course Objectives

- To impart knowledge about various sensors in multidisciplinary engineering domain
- To understand the concept of sensing circuits and its static and dynamic characteristics
- To familiarize students with different applications and its material handling technology

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Summarize the static and dynamic characteristics of measuring instruments
2. Compare the characteristics and working principles of Resistance, Inductance and Capacitance type sensors
3. Construct the interfacing and signal conditioning circuit for measurement system using different types of sensor
4. Select suitable sensor for different industrial applications
5. Integrate the modern technologies to design various sensors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2										
2	2	2	1	3										
3	1	3	2	2										
4	1	2	3	2										
5	1	1	2	3										

UNIT I **8 Hours**

SENSORS FUNDAMENTALS AND CHARACTERISTICS

Sensors: Principles of Sensing-Sensor Classification and terminology- Units of Measurements - Measurands- Sensor Characteristics: static and Dynamic.

UNIT II **8 Hours**

PHYSICAL PRINCIPLES OF SENSING

Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements

UNIT III **9 Hours**

INTERFACE ELECTRONIC CIRCUITS

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

UNIT IV **10 Hours**

SENSORS IN DIFFERENT APPLICATION AREA

Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors

UNIT V **10 Hours**

SENSOR MATERIALS AND TECHNOLOGIES

Materials, Surface Processing-MEMS microsystem components- Microfluidics microsystem components - Nano-Technology- Electronic/wireless integration

Total: 45 Hours

Reference(s)

1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer
2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
3. Mechatronics -Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited)

15EI0YG INDUSTRIAL PROCESS AUTOMATION 3 0 0 3

Course Objectives

- To understand the fundamentals of Programmable Logic Controller(PLC), Supervisory Control and Data Acquisition (SCADA) and Distributed Control System (DCS)
- To program and configure the advanced controller for a given application
- To familiarize the functions of different communication protocols

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Interpret the architecture and concepts of PLC program
2. Execute PLC and Supervisory Control and Data Acquisition (SCADA) for various applications
3. Examine the concepts of Distributed Control System
4. Analyze the interfacing methods in DCS
5. Implement the communication protocol for given application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2	1									
2	2	2	1	3	2									
3	1	3	2	2	1									
4	1	2	3	2	1									
5	1	1	2	3	1									

UNIT I **9 Hours**

PROGRAMMABLE LOGIC CONTROLLER

Evolution of PLCs- Components of PLC - Architecture of PLC - Discrete and analog I/O modules - Programming languages -- Ladder diagram

UNIT II **8 Hours**

PLC SCADA AND ITS APPLICATIONS

Instructions in PLC - Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions - Introduction to SCADA - components of SCADA - features of SCADA

UNIT III **8 Hours**

DISTRIBUTED CONTROL SYSTEM

DCS - Various Architectures - Comparison - Local control unit - Process interfacing issues

UNIT IV **10 Hours**

INTERFACES IN DCS

Operator interfaces - Low level and high level operator interfaces - Displays - Engineering interfaces - Low level and high level engineering interfaces - Factors to be considered in selecting DCS

UNIT V **10 Hours**

COMMUNICATION PROTOCOLS

Introduction to communication protocols- TCP/IP protocol - HART communicator protocol - Media access Protocol- Data link control protocol - PROFI bus - Mod bus - CAN bus- Field bus: General Field bus architecture, Field bus standard, Field bus topology

Total: 45 Hours

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India,2012
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes/Elsevier, 2013
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2011
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013
6. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1985

15EI0XA INDUSTRIAL SAFETY STANDARDS FOR INSTRUMENTATION PRODUCTS

1 0 0 1

Course Objectives

- To acquire basic concepts of instrumentation in food, petro chemical and continuous process industries.
- To provide an awareness on the different safety standards.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. To acquire basic concepts of instrumentation in food, petro chemical and continuous process industries.
2. To provide an awareness on the different safety standards.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1				3	3						2
2		1	1			1	3	3						2

UNIT I **15 Hours**

SYLLABUS

Introduction to instrumentation involved in food industry / petrochemical industry /continuous process industry - Different standard requirements for safety products - Hazardous environment and instrumentation - Protection methods for instrumentation electronics - Wiring and installation best practices

Total: 15 Hours

Reference(s)

1. Nicholas P. Cheremisinoff, Practical Guide To Industrial Safety, Marcel Dekker, Inc, 2006
2. Walt Boyes, Instrumentation Reference Book, Butterworth-Heinemann, 2008

15EI0XB EMBEDDED SYSTEM DEVELOPMENT USING PIC MICROCONTROLLERS

1 0 0 1

Course Objectives

- To impart necessary knowledge in Embedded systems and PIC.
- To understand the concepts of PIC Microcontrollers and its Industrial applications.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. To impart necessary knowledge in Embedded systems and PIC.
2. To understand the concepts of PIC Microcontrollers and its Industrial applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2			2								
2		1	2		1	2								

UNIT I **20 Hours**

SYLLABUS

Introduction to PIC Microcontrollers - C Programming for PIC - PIC Development Tools - LED and LCD Interface and programs - Serial communication - Analog interfacing - Sensor interfacing - Advanced PIC Project - Working with SD card - USB bus interface and programming - CAN bus interface and programming - Multi-tasking and Real-Time Operating Systems

Total: 20 Hours

Reference(s)

1. Martin Bates, "Interfacing PIC Microcontrollers", Elsevier 2010
2. Martin Bates, PIC Microcontrollers An Introduction to Microelectronics, Elsevier 2012
3. http://www.microchip.com/pagehandler/en-us/products/wireless/applications/homeindustrial.html

15EI0XC DETAILED INSTRUMENTATION ENGINEERING

1 0 0 1

Course Objectives

- To acquire basic knowledge in understanding the piping and instrumentation diagrams.
- To understand the standards used in industry for different applications.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. To acquire basic knowledge in understanding the piping and instrumentation diagrams.
2. To understand the standards used in industry for different applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3											
2	1	2	3											

UNIT I **20 Hours**

SYLLABUS

Process flow diagrams - P&ID concepts - Standards and symbols - Indications on P&ID - Conventions in P&ID - Instrumentation standards - API - IEC - ISA - Selection and sizing of instruments - Selection and sizing of valves - Project management

Total: 20 Hours

Reference(s)

1. Instrumentation symbols and identification - ISA 5.1, International Society of Automation
2. Process Measurement Instrumentation - API RP 551, International Society of Automation

15EI0XD EMBEDDED SYSTEMS IN INSTRUMENTATION AND CONTROL

1 0 0 1

Course Objectives

- To understand the relationship between basic electronic components and embedded system
- To analyse the digital system design

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. To understand the relationship between basic electronic components and embedded system
2. To analyse the digital system design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3											2
2	1	2	3											2

UNIT I **20 Hours**

SYLLABUS

Basic Electrical Components: Resistors, Inductors and Capacitors - Basic Electronic Components: Diode, Transistor, ICs - Common Electric and Electronic Components: Transformers, Voltage regulators, Optocoupler, MOSFET and IGBT - Foundations: Basics - Sketch: Microcontrollers: Digital pins - Analog input pins - PWM - Programming technique - FPGA controller: Introduction, I/O configurations and PC interfacing - VHDL an overview - Programming methods - Interface with MATLAB - An overview of DSP controller - An overview of dSPACE controller

Total: 20 Hours

15EI0XE ENERGY MANAGEMENT SYSTEMS IN INDUSTRIES

1 0 0 1

Course Objectives

- To understand the role of an instrumentation engineers in energy conservation.
- To acquire an awareness on EMS 14000 / EMS 50000 standards.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. To understand the role of an instrumentation engineers in energy conservation.
2. To acquire an awareness on EMS 14000 / EMS 50000 standards.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3			3		1						
2	1	2	3			3		1						

UNIT I **20 Hours**

SYLLABUS

Need for energy conservation in manufacturing / process industries - Role of instrumentation engineer in energy conservation programme - Practical case studies on development of instrumentation and control for energy management programme - Energy measurement - Data logging methods - Modbus, Can Bus & Ethernet protocols - Hands on training in development of an energy management system with LabVIEW

Total: 20 Hours

Reference(s)

1. Richard A. Panke, Energy Management Systems and Direct Digital Control, 2011.
2. Dr. ParagDiwan& Mohammed, Energy Management, Pentagon Energy Earth, 2012.

15EI0XF DESIGN OF LOW COST AUTOMATION FOR INDUSTRIES **1 0 0 1**

Course Objectives

- To impart necessary knowledge in designing and building a Low cost automation controls in manufacturing and process industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. To impart necessary knowledge in designing and building a Low cost automation controls in manufacturing and process industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3				1							2

UNIT I **20 Hours**

SYLLABUS

Introduction to manufacturing and process industries - Need for automation - Need for low cost automation -Automation system development methodologies - Interoperability in automation products - OLE / OPC Standards - Testing and validation of automation systems - Introduction to factory acceptance test - Hands on Designing an low cost SCADA with LABVIEW

Total: 20 Hours

Reference(s)

1. John Park, Steve Mackay, Practical Data Acquisition for Instrumentation and Control Systems, Elsevier, 2010
2. Terry Bartelt, Industrial Automated Systems: Instrumentation and Motion Control, CENGAGE Learning, 2011

15EI0XG MODELING AND ANALYSIS OF INSTRUMENTATION **1 0 0 1**

Course Objectives

- To analyse the solutions for instrumentation problems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. To analyse the solutions for instrumentation problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3				1							2

UNIT I **20 Hours**

SYLLABUS

Working with the MATLAB User Interface - Variables and Expressions - Automating Commands with Scripts - Analysis and Visualization with Matrices - Analysing Data from Files - Flow Control - Writing Functions - Creating and Simulating a Model - Modeling Programming Constructs - Modeling Discrete Systems - Modeling Continuous Systems - Instrumentation linear and nonlinear system examples with MATLAB/Simulink

Total: 20 Hours

Reference(s)

1. KristerAhlersten, An Introduction to Matlab, BookBoon , 2012.
2. Fornetti Francesco, Instrumentation Control, Data Acquisition and Processing with MATLAB, Explore RF Ltd, 2013.

15EI0XH DESIGN OF LINEAR WEIGHING MACHINE 1 0 0 1

Course Objectives

- To understand the function of packaging machine.
- To introduce elements of automation - Sensing, Actuation and Control.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. To understand the function of packaging machine.
2. To introduce elements of automation - Sensing, Actuation and Control.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					2									
2	1	2	3			1	2	1						

UNIT I **20 Hours**

SYLLABUS

Introduction to Packaging Machinery - Need for Packaging Machines - Types of Packaging Machines - Basic components of a Linear Weighing Machine - Hook-up Diagram of a Linear Weighing Machine - Selection of Load Cell and its Interface circuitry (Pre-amp, ADC) -Introduction to Electromagnetic Vibrator and its Control (TRIAC, Firing Angle Control) PLC or Microcontroller based Control - Control Algorithm Basics and its Implementation HMI, Recipe settings and Calibration - Customer Requirements : Speed, Accuracy, Reliability, Repeatability

Total: 20 Hours

Reference(s)

1. George Crispe Whiteley,The Law Relating to Weights, Measures, and Weighing Machines,Knight and Company,2011.
2. Shimon Y. Nof,Springer Handbook of Automation,Springer Science & Business Media,2010

15EI0XI HIGH TEMPERATURE INSTRUMENTATION 1 0 0 1

Course Objectives

- The course is intended to build up necessary background for understand principles of heat flux measurements and their applications
- To import knowledge on high temperature measurements
- To learn the knowledge on various types of sensors for high temperatures for use in propulsion and other applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. The course is intended to build up necessary background for understand principles of heat flux measurements and their applications in aerospace
2. To import knowledge on high temperature measurements
3. To learn the knowledge on various types of sensors for high temperatures for use in propulsion and other applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3				2							
2	1	2	3				2						1	
3	1	2	3				2							1

UNIT I **20 Hours**

SYLLABUS

Introduction - importance of high temperature measurements in Aerospace industry - Heat flux measureme nt - Types of heat flux sensors - slug gauge, Gordon gauge, Thermopile and thin film gauges - calorimetric methods - calibration of heat flux sensors using black bodyfurnace - Types of thermocouples and their calibration, combustion chamber temperature measurements using refractory thermocouples - surface temperature measurement techniques using thermo couples and pyrometers - optical, radiation, two colour and infrared pyrometers - spectroscopic methods for flame temperature measurement - Sodium line reversal method, LDA etc. Total temperature measurements - recovery factor calibration - major errors associated with high temperature measurements and estimation of accuracies

Total: 20 Hours

Reference(s)

1. J.P Hartnett et al, Recent Advances in Heat and Mass Transfer, Literary Licensing, LLC, 2012
2. R.P. Benedict, Fundamentals of temperature, pressure and flow measurements, Third Edition,1984
3. ASTM committee on E20, Manual on the use of thermocouples in temperature measurement, ASTM publication,1981

15EI0XJ CALIBRATION TECHNIQUES 1 0 0 1

Course Objectives

- To impart necessary knowledge in calibration techniques and its applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Understand the calibration techniques in field instruments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3				2							2

UNIT I **15 Hours**

CALIBRATION

Introduction - Industry Protection Standards - Temperature Calibration - Resistance Temperature Detectors (RTD) - Thermocouple - Thermostat - Calibration ofPressure Transmitter - Pressure
switches with Documenting Process Calibrators (DPC)- Calibration of Control Valve Positioner - Loop Calibration and Maintenance- Calibrating Highway Addressable Remote Transducer (HART) communication protocol based transmitters- Calibration of non-contact type transmitters

Total: 15 Hours

Reference(s)

1. Mike Cable, "Calibration - A Technician's Guide, The Instrumentation, Systems and Automation Society, 2014.

15EI0XK HOOK-UP DIAGRAM 1 0 0 1

Course Objectives

- To give basic knowledge in obtaining the Hookup diagram for different transmitters

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Design and implement the hookup diagram concepts for different applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3				2							2

Total: 15 Hours

Design and implementation of hookup diagram concepts for different applications -Material selection for Installation - Hookup diagram for pressure transmitters: steam, gas and liquid pressure transmitters - Hookup diagram for Level transmitter, calculation for level and pressure transmitters - Hookup diagram for flow transmitters: steam, gas and liquid flow transmitters- Installation of vortex and magnetic flow meter -Hookup diagram for Temperature Transmitter

Total: 15 Hours

Reference(s)

1. Hook-up Designs for Steam & Fluid Systems, Spirax Sacro, Inc., 2014

15EI0XL INTERNET OF THINGS (IOT) WITH SENSOR DATA ACQUISITION IN CLOUD

1 0 0 1

Course Objectives

- To impart fundamental knowledge in Internet of Things and its applications
- To understand the concepts of logging sensor data into the Cloud
- To understand the concepts of Internet of Things, Data Acquisition and working with Cloud

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. To understand the concepts of Internet of Things, Data Acquisition and working with Cloud

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3		2		3							3

UNIT I **15 Hours**

Introduction to Internet of Things (IoT) - Understanding of CC3200 ARM+ WiFi Controllers - Code Composer Studio (CCS) Development Tools - Working with Access Point (AP) and Station Modes of WiFi - Working with GPIO and ADC to enable sensors for analog and digital input and actuators - Serial Connectivity with Universal Asynchronous Receiver/Transmitter (UART) - Data Acquisition of Sensors and Logging into the Cloud - Understanding of Web Dash board with TI Exosite Cloud Services

Total: 15 Hours

Reference(s)

1. Arshdeep Bagha& Vijay Madisetti, Internet of Things Ã¢?? A Hands-On Approach, VPT, 2014.
2. www.ti.com/product/cc3200

15EI0XM VFD BASED INDUSTRIAL APPLICATIONS 1 0 0 1

Course Objectives

- To know working and control schemes of VFD and its applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Learn the basic concepts and control of VFD in various applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2									1		

UNIT I **20 Hours**

VFD BASED INDUSTRIAL APPLICATIONS

Basic terminology associatedwith motors and Variable speed drives - Type of Motors, constructionand their operating principle - Basic principle of starters and variable speed drives - Methods of starting of motors - Main functions of starters and Variable speed drives - Differenttypes of Drives- Variable Frequency and Variable Voltage drives - Different control modes of VFDs - Discrete and Continuous control schemes - Effect of long distance cables on VFDs Ã¢?? Differenttypes of braking - Selection of VFDs based on application

Total: 20 Hours

Reference(s)

1. www.drivesmag.com
2. "Guide to Variable Speed Drives - Technical Guide No. 4". Retrieved Jan 27, 2012.

15EI0XN IoT USING RASPBERRY PI 1 0 0 1

Course Objectives

- To understand the concepts of IoT using Raspberry Pi

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Develop Phyton Programming in IoT applications using Raspberry Pi

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2											

UNIT I **15 Hours**

IOT USING RASPBERRY PI

Introduction to IoT - PYTHON Programming - Accessing Internet - SMTP mail server - Camera Interfacing and its Applications - Creating a project on security - HTML Programming - Interfacing of Analog Sensors - IoT based Location Finder with Map Integration - IoT based Electrical Applications (Demo) - Linking MATLAB and Raspberry Pi

Total: 15 Hours

Reference(s)

1. Simon Monk, Programming the Raspberry Pi: Getting Started with Python, McGraw Hill, 2013.

15EI0XO DESIGN OF POWDER FILLING MACHINE 1 0 0 1

Course Objectives

- To familiarize the processing techniques of various machines in industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. Understand the design criteria and control techniques of process machine in process industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2				2							1

UNIT I **15 Hours**

DESIGN OF A POWDER FILLING MACHINE

Introduction to Packaging Machinery - Need for Packaging Machines - Types of Packaging Machines - Basic components of a Powder Filling Machine - Design of Agur, Stirrer, Web puller, Hopper - Control of Induction Machine and VFD demon- PLC or Microcontroller based Control - Control Algorithm Basics and its Implementation - HMI, Recipe settings and Calibration

Total: 15 Hours

Reference(s)

1. Christopher G J Baker, M.D. Ranken, R.C. Kill, Food Industries Manual, McGraw Hill, 2013.

15EI0XP IoT USING PYTHON 0 0 0 1

Course Objectives

- To familiarize the concepts of IoT and its application

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Exploit sensors to measure physical quantities and design signal conditioning circuits
n. Apply instrumentation systems and advanced controllers for automation

Course Outcomes (COs)

1. To understand the PYTHON programming in IoT

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2			2	2						1		1	1

Total: 20 Hours

Introduction and Impact of IoT – Advanced PYTHON Programming – Linux Fundamentals – Usage of Library Files and File handling - Introduction to internet access, Getting weather forecast updates – Using SMTP mail server – Introduction to open CV – Installing open CV in Raspberry Pi – Basic Image Processing Techniques – Color identifying, tracking and drawing to create a sample digital art – Face detection and localization

Total : 20 Hours

Reference(s)

1. Gaston C. Hillar, Internet of Things with Python, Packt Publishing, May 20, 2016

15EI0XQ PRODOK SOFTWARE 1 0 0 1

Course Objectives

- To familiarize in planning and operational management of process control equipment of process plants using PRODOK

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. To understand the scope of PRODOK NGÃ¢??s functions and fulfills the requirements of Instrumentation and Control project engineers

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			2									

UNIT I **20 Hours**

PRODOK

Instrument list - Instrument index - Signal list - Device specification sheets - List of power consumers - Hookup diagrams - Logic diagram - I/O list - Loop diagrams - User Management- Project Management - Master Data Management - Basic-Engineering - Creation of customized equipment specifications - Logic diagrams - Document management

Total: 20 Hours

Reference(s)

1. https://www.roesberg.com/en/it-solutions/trainings/prodok-basic-engineering.html

15EI0XR VIRTUAL INSTRUMENTATION IN INDUSTRIAL AUTOMATION

1 0 0 1

Course Objectives

- To understand the role of LabVIEW in Industries for Instrumentation Engineers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. To apply virtual instrumentation concepts in industrial automation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			2									

UNIT I **20 Hours**

LABVIEW

LabVIEW in Advanced Instrument Control and industrial Automation - Role of LabVIEW in Industry 4.0 - LabVIEW Environment - Decision making and looping architecture - Hands on Virtual Instrument Development - Hand-on Data Acquisition, Analysis and File Handling operations - Data logging methods - Hands on PID based Control Application development using LabVIEW

Total: 20 Hours

Reference(s)

1. Instrumentation systems - ISA 5.1, International Society of Automation
2. Industry 4.0 - https://en.wikipedia.org/wiki/Industry_4.0
3. Virtual Instrumentation Using LabVIEW - Sanjay Gupta, Joseph John https://books.google.co.in/books/about/Virtual_Instrumentation_Using_Labview_2E.html?id=en1GKs2huTcC&redir_esc=y

4. http://sine.ni.com/cs/app/doc/p/id/cs-17475
5. http://sine.ni.com/cs/app/doc/p/id/cs-13566

15EI0XS PLC PROGRAMMING 1 0 0 1

Course Objectives

- To impart knowledge about automation and architecture of PLC
- To understand the PLC programming using timers, counters and advanced PLC functions
- To familiarize the student with applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

6. Summarize the architecture and components of PLC
7. Select the suitable PLC Programming languages
8. Attribute the various functions and instruction sets of PLC

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			2									
2	2	2			2									
3	2	2			2									

Total: 0 Hours

Introduction to PLC - Components – Architecture - Programming Languages - Ladder logic - Function block diagram (FBD) - Structure text - Ladder logic components: Boolean logic using ladder logic programming-Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter - Program Control Instructions, Math Instructions, Data Manipulation Instructions: Data compare operations, Data transfer operations - Sequencer and Shift register instructions- Analog Instructions: PID Controller - Scaling Instructions

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India,2014.
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes/Elsevier, 2015
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014

15EI0XT PIPING AND INSTRUMENTATION 1 0 0 1

Course Objectives

- To acquire basic knowledge in piping and instrumentation diagram
- To enable students to design piping and instrumentation diagram for different application

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Summarize the concepts piping and instrumentation
2. Design piping and instrumentation for given application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			2									
2	2	2			2									

Total: 20 Hours

Symbols and layout – loop diagram – tagging conventions – line and function symbols – equipment representation - Pump selection – pressure drop in pipelines – power requirements for pumping liquids – characteristics curves for centrifugal pumps – system curve – net positive suction head – pump and other shaft seals - Wall thickness: pipe schedule – pipe supports – pipe fittings – pipe stressing – layout and design – pipe size selection – examples: Basic neutralizer control system, basic column control, batch reactor control system, continuous feed and recycle tank - Process design of fluid moving devices – flow meters – process design of orifice meter – process design of rotameter – two phase flow – troubleshooting of fluid flow system

Reference(s)

1. Terrence L. Blevins, Mark Nixon, *Control Loop Foundation: Batch and Continuous Processes*, ISA, 2017.
2. R. K. Sinnott, John Metcalfe Coulson, John Francis Richardson, Chemical engineering design, Elsevier Butterworth-Heinemann, 2014
3. S.B Thakore, B.I Bhatt, *Introduction to Process Engineering and Design*,Tata McGraw-Hill, 2007

15GE0XA HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts.
2. Understand the fundamental concepts of yogic practice and physical fitness.
3. To acquire the knowledge about nutrition and health consciousness.

Fitness: Meaning & Definition – Need & importance of Physical fitness – Types Physical fitness - Exercise, Training and Conditioning and it is important.

Yoga: Meaning and definition – Principles of practicing – Basic Asana and it important – Pranayama and Meditation - Relaxation Techniques.

Nutrition and Balance Diet: Needs and Important – Significant of Nutritional Food - Tips for balance diet. **Common Diseases for IT professionals:** Common diseases - cause – prevention – First aid for common sports injuries.

Total: 15 hours

References

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). *Getting in Shape Workout Programs for Men&Women*. Mumbai: Jaico Publishing House.
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). *Essentials of Strength Training and Conditioning*. Champaign: Human Kinetics.
3. Iyengar, BKS., (2003). *The Art of Yoga*. New Delhi: Harper Collins Publishers.
4. Singh, Hardayal, (1995). *Science of Sports training*. New Delhi: D.V.S. Publications.
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited.

15GE0XB FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY 1 0 0 1

Course Objective

- The course focuses on community radio technology and various program productions techniques for radio broadcasting.

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording
2. Examine the available options for telephony interfaces for radio
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

INTRODUCTION TO COMMUNITY RADIO

Evolution of Community Radio (CR) in India- principles behind setting up of CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

STUDIO TECHNOLOGY

Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production- telephony interfaces for radio- audio Post Production

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable- propagation and coverage of RF signals-FM transmitter setup

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, "Other Voices: The Struggle for Community Radio in India", SAGE Publications India,2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Seán Ó Siochrú, "Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation", University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.procosound.com

15GE0XC VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills.

Course outcome (CO)

1. Solve problems creatively in mathematics and its applications.

Vedic Mathematics

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations-

Total: 15 Hours

References

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014.
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997.

15GE0XD INTRODUCTION TO ALGORITHM 1 0 0 1

Course Objectives

- Analyze the asymptotic performance of algorithms, Divide and conquer and Dynamic Problems.
- Use Sorting and Searching algorithms for arranging the data.
- Apply important algorithmic techniques to solve the real world Problems.

Course Outcomes (COs)

1. Apply Divide and conquer and Dynamic Programming Algorithm techniques to Provide the solutions for simple Problems.
2. Design algorithms for Performing Sorting and Searching of data.
3. Construct the Graph, Heap and BST for the given Data information.

Algorithm Design Techniques: Divide and Conquer, Dynamic Programming, Sorting and Searching, Basic graph algorithms –Simple Data Structures: Heaps, Balanced Search Trees.

Total: 15 Hours

References

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015.
2. Thomas H. Cormen. Charles E. Leiserson. Ronald L. Rivest. Clifford Stein, Introduction to Algorithms, Second Edition, MIT Press, 2014.

3. J.P.Tremblay and P.G.Sorenson, An Introduction to Data Structures with Application II Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

15GE0XE ETYMOLOGY

1 0 0 1

Course Objectives:

- To enhance the level of vocabulary by understanding the origin / root of English words
- To stimulate an appreciation for the English language
- To promote effective oral and written communication through improved vocabulary

Course Outcome (COs):

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

CONVENTIONS &VOCABULARY

Acronyms – Abbreviations – Initialisms – Jargon – Neologisms - Idiomatic Expressions – Euphemisms – Spoonerisms – Malapropisms – Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym – Apheresis - Blend word Assimilation - Colloquial language Clipped word

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis – Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total : 15 hours

Reference(s)

1. Norman, Lewis. *Word Power Made Easy*,Goyal Publisher. Edition 2.2014.
2. C T Onions. *The Oxford Dictionary of English* Etymology.Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont.Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library.1961

15GE0XF HINDUSTANI MUSIC

1 0 0 1

Course Objectives:

- To have an awareness on aesthetic and therapeutic aspects of Hindustani music
- To identify and differentiate the various styles and nuances of Hindustani music
- To apply the knowledge accumulated throughout the duration of the course by way of improvisation, composition and presentation

Course Outcomes (COs):

1. Have Basic knowledge of aesthetic and therapeutic value of Hindustani Music

AESTHETICS

Introduction to music - Aesthetics of Hindustani Music - Classification (Raga, instruments, style as per the presentation and the gharaanaas) - Folk music, Dhamaar, Dhrupad

COMPOSITION AND THERAPEUTIC VALUE

Taal and Raga - Bandeesh, Taraanaa – Madhya and drut laya, Vilambit khyaal as demonstration - Therapeutic benefits of Hindustani music - Stage performance

Total : 20 hours

Reference(s):

1. Devdhar B.R., *Raga bodh (Part 1 & 2),* Devdhar School of Indian Music, Mumbai, 2012.
2. Vasant, *Sangeet Vishaarad* , Hathras, Uttar Pradesh, 2015.

Websites:

1. *raag-hindustani.com/*
2. *play.raaga.com/Hindustani*
3. *raag-hindustani.com/Scales3.html*
4. *www.poshmaal.com/ragas.html*
5. *www.soundofindia.com/raagas.asp*
6. *https://www.quora.com/Which-is-the-toughest-raga-in-Indian-classical-music*
7. *www.likhati.com/2010/10/20/popular-ragas-for-the-beginner-ear-durga*

15GE0XG CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING 1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious.

VERMICOMPOSTING TECHNOLOGY 15 Hours

Ecological roles and economic importance of earthworms - need for earthworm culture – scope and importance of vermiculture – limiting factors - types of worm culturing and the relative benefits – Small scale and commercial methods: process & advantages – Vermicomposting equipments, devices – Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle) – vermicastings in organic farming/horticulture - Marketing the products of vermiculture – quality control, market research, marketing techniques – Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives – Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times – Scientists Hope to Cultivate and Immune System for Crops

15GE0XH AGRICULTURE FOR ENGINEERS 1 0 0 1

Course Objectives

- To impart the basic knowledge of agricultural and horticultural crops, cropping systems
- To study the weed and nutrient management, irrigation water requirement and its quality

Course Outcomes (COs)

1. Understand the science of Agriculture
2. Summarize and apply the methodologies needed in agriculture based on the field conditions.
3. Develop enough confidence to identify the crop patterns in real world and offer appropriate solutions.

AGRONOMICAL PRACTICES AND CROPS 5 hours

Definition and scope of agronomy , Classification of Crops, agricultural and horticultural crops Effect of Different Weather Parameters on Crop Growth and Development , Principal of Tillage, Tilth and Its Characteristics, Role of Water in Plant and Its Absorption, Conduction and Transpiration of Water and Plant Processes, Soil Water Extraction Pattern and Plant Response. Introduction to weeds, Weeds Control.

CROP ROTATION, CROPPING SYSTEMS, RELAY AND MIXED CROPPING 5 hours

Crop Rotation, Different Cropping Systems – I, Different Cropping Systems – II, Scope of Horticultural Crops, Soil Requirement for Fruits, Vegetables and Flowers Crops, Climatic Requirement for Fruits, Vegetables and Flowers Crops.

PLANT NUTRIENTS 5 hours

Essential Plant Nutrients, Nutrient Deficiency, Toxicity and Control Measures. Chemical fertilizers, fertilizer Reaction in Soil and Use Efficiency

QUALITY OF IRRIGATION WATER AND IRRIGATION METHODS 5 hours

Quality of Irrigation Water, Poor Quality of Irrigation Water and Management Practices. Surface Irrigation methods, and micro irrigation methods

Total:20 hours

References

1. SP. Palaniappan, and S. Sivaraman, Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.
2. S.Sankaran and V.T Subbaiah Mudaliar, Principles of Agronomy, The Bangalore Printing and Pubg Co, Bangalore, 1993.
3. P.Balasubramain and SP. Palniappan, Principles and Practices of Agronomy, Agrobios publishers, Ludhiana, 2001.
4. T.Yellamanda Reddy and G.H. Sankara Reddi, Principles of Agronomy, Kalyani publishers, Ludhiana, 2005
5. B.Chandrasekaran, B. , K. Annadurai and E. Somasundaram, A Text book of Agronomy, Scientific publishers, Jodhpur, 2007
6. George Acquaah, Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd., New Delhi, 2002.

15GE0XI INTRODUCTION TO DATA ANALYSIS USING SOFTWARE 1 0 0 1

Course Objectives

- To familiarize students on the features of MS Excel.
- To enable the students to use Excel in the area of critical evaluation.
- Facilitate the student to construct graphs.

Course Outcomes (COs)

1. Create versatile Excel document.
2. Apply built in functions for data analysis.
3. Prepare dynamic Charts.

EXCEL FUNDAMENTALS AND EDITING 4 Hours

Starting and Navigating a Worksheet– Entering Information – Hyperlinks – Saving – Editing Techniques – Entering a Series of Labels, Numbers and Dates – Checking Errors.

FORMATTING 4 Hours

Formatting Cells – Changing Column Widths and Row Heights – Creating Conditional Formatting – Using Styles – Creating and Modifying Templates – Changing Page Breaks.

POWER ORGANIZING AND CUSTOMIZING EXCEL 4 Hours

Managing Worksheets – Referencing Cells in Other Worksheets – Using More than One Work Book – Managing Shared Work Books – Protecting Worksheets and Workbooks. Adjusting Views – Setting Printing Options – Using Multiple Panes – Customizing Excel Using the Options Dialog Box.

CRUNCHING NUMBERS 5 Hours

Building a Formula – Using Basic Built-in Functions – Using Functions to Analyze Data – Using Names in Functions – Array Functions

WORK SHEET CHARTS 3 Hours

Planning a Chart – Creating Chart – Formatting a Chart – Adding Labels and Arrows.

Total: 20 Hours

References

1. Michael J. Young, Michael Halvorson, “Office System 2007 Edition”, Prentice-Hall of India (P) Ltd., New Delhi, 2007
2. John Walkenbach, “Microsoft Office Excel 2007”, Wiley Publishing, Inc. 2007
3. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007
4. Mark Dodgeand Craig Stinson, “Microsoft Office Excel 2007 Inside Out”, Microsoft Press, 2007

15GE0XJ ANALYSIS USING PIVOT TABLE 1 0 0 1

Course Objectives

- To familiarize students on the features of Pivot Table.
- To enable the students to use Pivot Table in the area of data analysis.
- Facilitate the student to construct the charts for visualization of data.

Course Outcomes (COs)

1. Able to construct the Pivot Table and Group, Sort, Filter the Data to do the analysis.
2. Able to do the Calculation with in Pivot Table for advance analysis.
3. Capable of Constructing Pivot Charts to make visual presentation.

PIVOT TABLE FUNDAMENTALS **4 Hours**

Introduction about Pivot Table, Why and When to use the Pivot Table, Anatomy of the Pivot Table, Limitations, Preparing the Source Data, Creating the Pivot Table.

GROUPING PIVOT TABLE DATA **4 Hours**

Grouping the Items in a Report Filter, Grouping Text Items, Grouping Dates by Month, Grouping Dates Using the Starting Date, Grouping Dates by Fiscal Quarter, Grouping Dates by Week, Grouping Dates by Months and Weeks, Grouping Dates in One Pivot Table Affects Another Pivot Table, Grouping Dates Outside the Range.

SORTING AND FILTERING PIVOT TABLE DATA **4 Hours**

Sorting a Pivot Field: Sorting Value Items, Sorting Text Items, Sorting Items in a Custom Order. Filtering a Pivot Field: Manual Filter, Label Filter, Value Filter, Multiple Filters.

CALCULATIONS WITHIN THE PIVOT TABLES **5 Hours**

Using Formulae: Creating a Calculated Field with and without "IF Condition, Calculated Item, Using Custom Calculations: % of Column, % of Row, % of Total, % Of, Running Total, Difference From, % Difference From, Index.

PIVOT CHARTS **3 Hours**

Creating a Normal Chart from Pivot Table Data, Filtering the Pivot Chart, Changing the Series Order, Changing Pivot Chart Layout Affects Pivot Table, Changing Number Format in Pivot Table Affects Pivot Chart, Converting a Pivot Chart to a Static Chart, Refreshing the Pivot Chart, Creating Multiple Series for Years

Total: 20 Hours

Reference(s)

1. Debra Dalgleish, "Excel 2007 - PivotTables Recipes A Problem-Solution Approach", Apress, 2007, (ISBN-13 (pbk): 978-1-59059-920-4)
2. Bill Felen and Michael Alexander, "Pivot Table Data Crunching for Microsoft Office 2007", Pearson Education, Inc., QUE Series.
3. Wayne L. Winston, "Microsoft Office Excel 2007: Data Analysis and Business Modeling", Microsoft Press, 2007
4. John Walkenbach, "Microsoft Office Excel 2007", Wiley Publishing, Inc. 2007.
5. Mark Dodgeand Craig Stinson, "Microsoft Office Excel 2007 Inside Out", Microsoft Press, 2007.
6. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007.

Total : 15 Hours

15GE0XL INTERVIEW SKILLS 1 0 0 1

Course Objectives:

- To develop an understanding of interview dynamics and techniques, and its importance in career enhancement.
- To train students to face interviews.

Course Outcomes (COs):

1. Demonstrate appropriate interview skills and attend all types of interviews
2. Participate in group discussions with confidence

Interview preparation - Overcoming interview nerves - Types of Interview - Handling questions - Group Discussion - Dynamics of group discussion - Presentation skills - E-mail etiquette - Body Language.

Total: 15 hours

References:

1. Gray Jack, Interviewing: Interview Questions - Job Interviews, New York : Great Reads Publishing, 2015.
2. Corfield Rebecca, Successful Interview Skills, New York: Kogan Page, 2006.
3. Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.
4. Butterfield Jeff, Soft Skills for Everyone, New Delhi: Cengage Learning, 2014.

15GE0XN JOURNALISM AND MASS COMMUNICATION

1 0 0 1

Course Objectives:

- T o offer a basic knowledge of mass communication and its various forms
- T o provide a basic understanding of mass communication in India

Course Outcomes (COs):

1. Understand the underlying principles of Journalism
2. Understand the importance, functions & scope of mass communication
3. Follow and adapt to the periodic changes in media

What is News - Components of a Newspaper - Structure of an Article - How to Write Headlines - Introduction to Script Writing - News Reporting - Advertising and Marketing - Online Journalism - Rules of Editing - Proof Reading - Optimization and Key Words - Media Ethics - TV Studies - Media Propaganda - Identifying Fake News - International Communication

Total: 15 hours

References:

1. Kumar, Keval. Mass Communication in India. IV Ed. Jaico Publishing House: 2012.

2. Agarwal, S.K. A Handbook of Journalism & Editorial Excellence. Jaico Publishing House: 2012.

15GE0XO VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives:

- To acquire fundamental knowledge on development of film making as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Course Outcomes (COs):

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

History of Cinema (Origin and Narrative) – Cinema as a visual medium -Significance of Editing – Styles of Editing – Editing as a methodology (Hollywood's Invisible Editing) – Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) – Different types of shots and angles – Film style and Narrative – (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) – Regional Cinema to National Cinema – Basics of Script Writing (Double and Single Column) – Basics of Video Production (script to screen) – Final submission of a script for five minutes short film.

Total: 15 hours

References:

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

15GE0XP YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives:

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Course Outcome (COs):

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

What is Yoga – History of Yoga - Yoga in today's scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga -Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar - Standing Asanas - Sitting Asanas

- Prone Asanas - Supine Asanas - Mudras-Relaxation - Pranayama - Meditation

Total:15 Hour

References:

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.

Websites:

1. http://www.sarvyoga.com/
2. http://www.wikihow.com/Do-Superbrain-Yoga

15GE0XQ CARNATIC MUSIC

1 0 0 1

Course Objectives

- To know the basics of Carnatic Music
- To foster a blend of practical and theoretical understanding of Carnatic Vocal music
- To give a brief understanding of History of Indian Music, Evolution of the Raga system, Tala system, Structure of compositions

Course Outcomes (COs):

1. Develop an understanding of the basics of Carnatic music
2. Understand the aspects of Carnatic music which will help to create a strong foundation in Carnatic Music

History of Carnatic music - History of Carnatic Composers - Music Technical Terms Part I: Music, Nadam, Sangeetham, Marga Sangeetham, Suddha Sangeetham, Desiya Sangeetham, Kalpita, Kalpana, Ahata Nadam, Anahata Nadam, Shruthi, Swaram, Swarasthanas, Seven Swaras, Tamil Swaras, Prakruthi, Vikruthi, Kamala, Tivra, Twelve Swaras, Arohanam, Avarohanam, Swarna Kalas, Thala Symbols, Sthayi - Music Technical Terms Part II: Ragas, Janaka Ragas, Janya Ragas, Melakartha Ragas, Upanga Ragas, Bhashanga Ragas, Akshara Kalas, Sangathi, Anya Swaram, Chakras and Meanings, Jaaru, Poorvangam, Thadu and Madu, Saptaham, Ashtakam, Uthrangam, Gamaga, Abhyasa Ghanam, Sapta Kriyas, Nisapta Kriyas, Three Sathanas, Sabahaa gananas, Alapana, Thala, Laghu, Dhrutham - Jantavarisai - Classification (Raga, Thala, Instruments) -12 Melakartha Schemes – Practical Exercises in Music

Total: 15 hours

References:

1. Bhagyalekshmy, S. Ragas in Carnatic Music. CBH Publications, 2003.
2. Deva, Bigamudre Chaitanya. An Introduction to Indian Music. Publications Division, Ministry of Information and Broadcasting, Government of India, 2015.
3. Sambamoorthy, P. South Indian Music. Indian Music Pub. House, 1954.

15GE0XR GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives:

- Defining Psychology and the subject matter of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology
- To explain social and work psychology of people and the need for mental health.

Course Outcomes (COs):

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the different fields of psychology and its uses
3. Deal people effectively in their personal and social life

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ-measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice-discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude

Total: 15 hours

References:

1. Atkinson & Atkinson, Introduction to Psychology, 6^{th} Ed McGraw-Hill Publications.1975.

2. Mishra, B. K, Psychology: The study of human behavior, 2^{nd} Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.

3. Baron, R. A., Branscombe.N.R, Social Psychology, 14^{th} Ed. New Delhi; PearsonEducation. 2016.

4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7^{th} Ed.Nehi: Tata McGraw Hill. 1993.

15GE0XS NEURO BEHAVIOURAL SCIENCE 1 0 0 1

Course Objectives:

- To provide an introduction to the Cognitive Neuro Science of languages
- To provide an understanding of the Cognitive processes

Course Outcomes (COs):

1. Identify the psychological problems that will impact mental health
2. Value ethical conduct in professional and personal life
3. Recognise the need for rationale and evidence in decision-making

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science - Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

Total: 15 hours

References:
1. Beck. Robert "Handbook of Physiology". Vol I. Oxford University Press March 15, 1996.
2. Horon C Philip "Sexology and Mind". Academic Press. 1993.
3. Blatteis M.Clark and Melvin J. Fregly Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996.

15GE0XT INNOVATION AND ENTREPRENEURSHIP

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification – ideation – MVPPositioning as an Entrepreneur – Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business Plan-Mentoring Session with Investors- Legal and Ethical Foundation for Startup – Types of startups and licensing systems - MSME - Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources – VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures – Valuation Challenge in Entrepreneurship - Entrepreneurship – Sustainability - Exit strategies and Start-up trends in India.

Total 15 Hours

Reference(s)
1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning,6th Edition, 2012.
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, published by the authors, 2010
3. Branson. R. "Business stripped bare", New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3rd edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher,2011.

15GE0XW DISRUPTIVE INNOVATION BASED START UP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Course outcomes

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups

DISRUPTIVE INNOVATION BASED START UP ACTIVITIES

Creativity linked innovation – Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? – Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company's capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly – Application of disruptive theories to complex problems and opportunities.

Total 15 Hours

References

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

15GE0XX VISION INDIA

1 0 0 1

(START UP INDIA, MAKE IN INDIA, IMPRINT INDIA, SMART CITIES etc.)

Course Objectives

- To make the participants understand as to how government schemes are creating a favorable frame work in India for innovation based entrepreneurship.
- To get the budding young entrepreneurs to appreciate the preparedness of stakeholders in the innovation handling machinery in India.

Course Outcomes (COs)

1. Understanding Indian competitiveness
2. Concept and methodology of national vision programmes
3. Latest avenues & opportunities for students or working professionals or women
4. Overview of Indian trends in the start-up scene

INDIAN VISION PROGRAMMES

Theme, Concept and Practice of Make in India (Experience in 3 Years) - India growth story after Make in India - Objectives and targets of Make in India - Nation building initiatives through Make in India – 25 Sectors under the *Swadeshi* Movement called Make in India - Future of 'Manufacturing in India' initiative - Programme and objectives of Startup India – DIPP - Incentives and benefits under Startup India - Startup India Hub - Various Government schemes helping Indian Startups - Features and benefits envisaged in stand up India - Mission, Features and Advantages of Skill India Programme – PMKVY -Promising scene of *Ayush* - Digital India /E-Governance / DEiTY (Digitalized India Platform) – Impacts of firms like Connect India – Clean India, Community led Environmental Action Network - Smart Cities Mission: Features and promises – Imprint India

Total 15 Hours

References

1. http://www.makeinindia.com/article/-/v/make-in-india-reason-vision-for-the-initiative/
2. https://www.startupindia.gov.in/
3. https://www.standupmitra.in/Home/SUISchemes
4. http://www.digitalindia.gov.in/content/about-programme

15EI0V1 LABVIEW PROGRAMMING FOR PROCESS CONTROL

Course Objectives

- To provide an overview of Virtual instruments
- To bring out the overview of the software
- To familiarize the student with the process control Applications

Course Outcomes (COs)

1. Summarize the basics of Virtual Instrumentation (VI).
2. Write simple programs using LabVIEW.
3. Analyze operating systems and hardware aspects of the VI
4. Develop VI for simple process control applications.

UNIT I

LABVIEW FUNDAMENTALS **4 Hours**

Introduction to LabVIEW- Dataflow programming- Graphical programming- Introduction to Control and Simulation

UNIT II

LABVIEW FOR PROCESS CONTROL **6 Hours**

LabVIEW program for linear model-Non linear model-LTI model-LTV model-Time series model- Data extraction- Conversions- Model dynamics- Frequency response- System interconnections

UNIT III

LABVIEW IDENTIFICATION AND CONTROL TOOLS 5 **Hours**

LabVIEW program for linear model-Non linear model-LTI model-LTV model-Time series model- Data extraction- Conversions- Model dynamics- Frequency response- System interconnections

Total: 15 Hours

REFERENCES

1. Norman A. Anderson "Instrumentation for Process Measurement & Control"
2. Karl J. Astrom "PID and Fuzzy Controllers"
3. http://www.ni.com/support/reference/books/instru.html

15EI0V2 MATLAB PROGRAMMING FOR CONTROL ENGINEERING

Course Objectives

- To understand the programming knowledge in MATLAB
- To model and analyse the system using MATLAB

Course Outcomes (COs)

1. Attribute the various tools in MATLAB software
2. Develop the model for non linear system using MATLAB Software

UNIT I

PLANT MODELLING AND ANALYSIS 4 Hours

Create a transfer function model-Create a state-space model.- Create a zero/pole/gain model-Extract numerator(s) and denominator(s)- Extract state-space matrices-Extract zero/pole/gain data-Conversion to transfer function-Conversion to state space-Conversion to zero/pole/gain-using MATLAB simulink

UNIT II

MODEL DYNAMICS 6 Hours

System poles- pole-zero map- DC gain- Natural frequency and damping of system poles- Pade approximation of time delays- Step response- Impulse response- Response to arbitrary inputs-MATLAB m-file.

UNIT III

CONTROL DESIGN 5 Hours

Root locus plot- Interactive root locus gain determination- Generate z-plane grid lines for a root locus or pole-zero map- SISO (single-input-single-output) pole placement- MIMO (multiple-input-multiple-output) pole placement using MATLAB command-line functions and m-file.

Total: 15 Hours

REFERENCES

1. Carnegie Mellon, Digital Control Tutorial, Control Tutorials for Matlab.
   (Available: http://www.engin.umich.edu/group/ctm/digital/digital.html)
2. Control System Toolbox 8.5, Mathworks, Inc.
   (Available: http://www.mathworks.com/access/helpdesk/help/toolbox/control/)
3. F. Haugen, Tutorial for Control System Toolbox for MATLAB, October 11, 2003.
   (Available: http://techteach.no/publications/control_system_toolbox/)

15EI0V3 C PROGAMMMING FOR INSTRUMENTATION

Course Objectives

- To understand the programming concept for Instrumentation using C
- To analyse the various tools used in C for controlling the process

Course Outcomes (COs)

1. Explain the programming techniques involved in C for controlling the non linear process
2. Analyse the various tools involved in c programming for instrumentation

UNIT I
BASICS **6 Hours**

Process Parameters- Process Interaction and Transaction Calls- Process Declarations- Process Creation-Process Values and Process Ids-Shared Memory Hazards-Program Organization Suggestions-Concurrent Programming Issues-Deadlock-Maximizing Concurrency- Polling-Exercises-Discrete Event Simulation-The Process Interaction Model of Simulation-Two Stage Queueing Network-Exercises

UNIT II
ADVANCED FACILITIES BASICS **5 Hours**

The Delay Statement- Timed Transaction Calls- The Accept Statement-The Select Statement- Collective Termination-Transaction Pointers- Asynchronous Transaction Calls-Examples-Exercises-Runtime Environment - Process Abortion-Process Priority-Number of Pending Transaction Calls- Giving Names to Process Instances- Processor Selection on a Multiprocessor- Interrupts and Transactions- Process Stack Size- Exercises

UNIT III
LARGE EXAMPLES **4 Hours**

Robot Controller-Concurrent Make-Window Manager-Exercises

Total : 15 Hours

References

1. Narain Gehani, William D. Roome, The Concurrent C Programming Language, Silicon Press, 1989.
2. http://www.mosaic-industries.com/instrument-control.html

BRIDGE COURSES

15EIB01 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To analyze the difference between DC and AC circuits.
- To Learn the fundamentals of semiconductors and BJT.

Course Outcomes (COs)

1. Understand the basic concepts of DC and AC circuits
2. Acquire knowledge in electrical machines.
3. Learn the fundamentals of semiconductor diode and its applications.
4. Analyze the characteristics of BJT.

UNIT I **6 Hours**

DC CIRCUITS

Definition of Voltage, Current, Power, Energy, Resistor, Inductor and Capacitor-Ohm's law-statement, Illustration and limitation - Kirchoff's Laws statement and Illustration-Resistance in series and voltage division technique - Resistance in parallel and current division technique

UNIT II **6 Hours**

AC CIRCUITS

Generation of single phase alternating emf - RMS value, average value, peak factor and form factor - Analysis of Pure Resistive, Inductive and Capacitive circuits - J operator - Representation of alternating quantities in rectangular and polar forms

UNIT III **6 Hours**

ELECTRICAL MACHINES

Constructional details of DC Machines - Principle of operation of D.C. generator - Methods of excitation - Self and separately excited generators - Principle of operation of D.C. motor - Transformer Constructional details - Principle of operation

UNIT IV **6 Hours**

SEMICONDUCTOR DIODE AND ITS APPLICATIONS

Semiconductor theory - Theory of P-N junction diode - Volt-Ampere Characteristics - Half wave and full wave rectifier - Average value - RMS value - Form factor - Peak factor - Ripple factor - Efficiency - Peak inverse voltage - Transformer utilization factor

UNIT V **6 Hours**

BIPOLAR JUNCTION TRANSISTOR

Structure and working of Bipolar Junction Transistor - Input and output characteristics of CE, CB and CC configurations

Total: 30 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic Electrical and Electronics Engineering, Oxford University Press, 2014

2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2012
3. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. William H.Hayt Jr, Jack E.Kemmerly, and Steven M.Durbin, Engineering Circuit Analysis, Tata McGrawHill Publishing Co Ltd, New Delhi, 2012.
5. Jacob. Millman, Christos C.Halkias, Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw Hill Publishing Limited, New Delhi, 3rd Edition 2011
6. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013

15EIB02 ELECTRIC CIRCUIT ANALYSIS

Course Objectives

- To formulate the solution for basic electric circuit problems.
- To compute electrical parameters like current, voltage and power using network theorems for AC and DC circuits.
- To differentiate single phase and three phase circuits.
- To analyze R, L, C components for resonance, coupling and transient response.

Course Outcomes (COs)

1. Find solution for electric circuit problems using mesh and node analysis.
2. Use network theorems to find solutions for AC and DC circuits.
3. Classify three phase circuits based on the loads in each phase.
4. Identify the behavior of circuits like resonance, coupling and transients.

UNIT I **6 Hours**

GRAPH THEORY AND BASIC CIRCUIT ANALYSIS

The graph of a Network, definitions of tree, co-tree, link, basic loop - Concepts of Impedance and Admittance - Mesh and Nodal analysis

UNIT II **7 Hours**

NETWORK THEOREMS FOR DC AND AC CIRCUITS

Superposition theorem - Thevenin's and Norton's theorem - Maximum power transfer theorem-Reciprocity theorem

UNIT III **5 Hours**

THREE PHASE CIRCUITS

Three Phase balanced and unbalanced systems - Analysis of 3 wire and 4 wire circuit with star and delta connected loads - Phasor diagram

6 Hour

UNIT IV

RESONANCE AND COUPLED CIRCUITS

Series and parallel resonance - Q factor and bandwidth - Resonant frequency of a tank circuit - Coupled circuits - Self and mutual inductances - Coefficient of Coupling - Analysis of coupled circuits

UNIT V **6 Hours**

TRANSIENTS

Introduction - Transient Response of RL, RC and RLC Circuits with step and sinusoidal inputs - Time Constant Analysis.

Total: 30 Hours

Reference(s)

1. William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuit Analysis, Eighth Edition, Tata McGraw Hill, 2013.
2. Sudhakar and S. P. Shyam Mohan, Circuits and Network Analysis and Synthesis, Fifth Edition, Tata McGraw Hill, 2015.
3. Charles K.Alexander, Fundamentals of Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Co Ltd, 2013.