B.E. (Electronics and Instrumentation Engineering)

2018 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

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BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2018

(CHOICE BASED CREDIT SYSTEM)

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

Regulation 2018 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 2018 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 2018-2019 for Regular admission (Academic year 2019-2020 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. Electronics and Communication Engineering
vii. Electrical and Electronics Engineering
viii. Electronics and Instrumentation Engineering
ix. Mechanical Engineering
x. Mechatronics

B. Tech. Programmes

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

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-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** courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science** courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

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

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

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 based on the following

Contact period per week	Credits
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory / Seminar / Project Work / etc.)	1

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semester I, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

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) from 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 one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.

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 for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In 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 SGPA/CGPA).

3.7 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.

3.8 A Student may be permitted to credit only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

3.9 Industrial Training / Internship

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation, in lieu of Industrial training.

Duration of Training / Internship	Credits
2 Weeks	1
1 Month	2
2 Months	3

3.10 Socially Relevant Projects

A Student may be permitted to carry out a socially relevant project during semester II to semester VI in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the Semester for the valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres 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. 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 case, if a student fails to register in 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. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.4.3 The student shall register Project work I in semester VII and Project work II in semester VIII 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, he/she 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 continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) 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.

6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

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 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 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

7.6 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

7.7 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. The Faculty Advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

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 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 laboratory 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.

10.4 For the End Semester examinations, both theory and 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 cum Evaluation committee of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in Continuous Assessment and End Semester Examinations. If the student gets <50% of marks in End Semester Examination, then the student will be awarded only RA (Reappearance) grade.

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 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'.

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 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.

11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the

results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 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	172	135
Agricultural Engineering	172	134
Automobile Engineering	170	133
Civil Engineering	171	133
Computer Science and Engineering	171	133
Electronics and Communication Engineering	172	131
Electrical and Electronics Engineering	170	131
Electronics and Instrumentation Engineering	170	131
Mechanical Engineering	170	131
Mechatronics	170	132
B.Tech. Programmes		
Biotechnology	172	134
Fashion Technology	172	134
Food Technology	170	132
Information Technology	170	132
Textile Technology	171	133

11.5 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 Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.6 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 of 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 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

The minimum number of students for applying relative grading system is 30. If the students' strength is less than 30 then absolute grading system will be applied. The relative grading system shall not be applied for laboratory and EEC courses.

12.4 The performance of a student will be reported using Letter Grades in absolute grading, each carrying certain points as detailed below: In relative grading, grades will be decided by the faculty concerned. A student who earns a minimum of 6 grade points in a course is declared to have successfully passed the course.

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.

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

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

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 SGPA and all the semesters, under consideration, in the case CGPA.

12.6 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).

12.7 For the non credit courses grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of SGPA/CGPA.

For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.

12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. 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.

12.9 **Supplementary Examinations**: If a student fails to secure a pass in theory course(s) of VIII semester examination, he/she is eligible to appear for a one time Supplementary Examination which shall be conducted at the end of VIII semester, for the subjects of VIII semester alone within 30 days from the date of declaration of the results.

12.10 Eligibility for the Award of Degree

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
ii. Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years reckoned from the commencement of the first semester to which the candidate was admitted.
iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.
iv. No disciplinary action is pending against the student.
v. The award of Degree must have been approved by the Syndicate of the University.

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 satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.
- Should have secured a CGPA of **not less than 8.50**
- Should **NOT** have been prevented from writing end semester examination due to lack of attendance in any of the courses.

13.2 **First Class**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 7.00**

13.3 Second Class: All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second Class.**

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 it is made within TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory TEN working days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s).

14.5 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.

14.6 Withdrawal is permitted for the end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years as per clause 13.1 & 13.2.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a fixed period of one year as a single break in the entire course of study.

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 / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Dean Academics in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

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 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:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	End Semester Examination	**50**
	Total Marks	**100**

II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	(Laboratory Assessment & Report)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**

III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (20)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (10)	
	Test – Cycle I (25)	
	Test – Cycle II (25)	
	Total Marks	**100**

IV	**PROJECT WORK I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Literature Survey (5)	
	Identification of topic and Justification (5)	
	Work plan (10)	
	Review II	
	Approach & Results (15)	
	Conclusion (15)	

	End Semester Examination	**50**
	Report[#] (20)	
	Presentation (20)	
	Viva voce (10)	
	Total Marks	**100**

V	**PROJECT WORK II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Progress (10)	
	Review II	
	Approach & Results (10)	
	Review III	
	Conclusion & Final Presentation (10)	
	Report (15)	
	Publication of Paper in Conferences / Journals (5)	
	End Semester Examination	
	Presentation (30)	**50**
	Viva voce (20)	
	Total Marks	**100**

VI	**LANGUAGE ELECTIVE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test 1	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Test 2	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Oral Exam	**50**
	Total Marks	**100**

VII	**ONE-CREDIT COURSE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**50**
	Quiz/ Assignment	**50**
	Total Marks	**100**

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

VIII	**INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Assessment by Industry	**30**
	Viva-voce	**20**
	Presentation	**30**
	Case Study / Report	**20**
	Total Marks	**100**

IX	**SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	

X	**VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	

XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Exercise (Minimum 10 Exercises/Modelling)	**60**
	Model Examination	**40**
	Total Marks	**100**

Optional Test: *A student becomes eligible to appear for an 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

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. 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. 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.

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)

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.

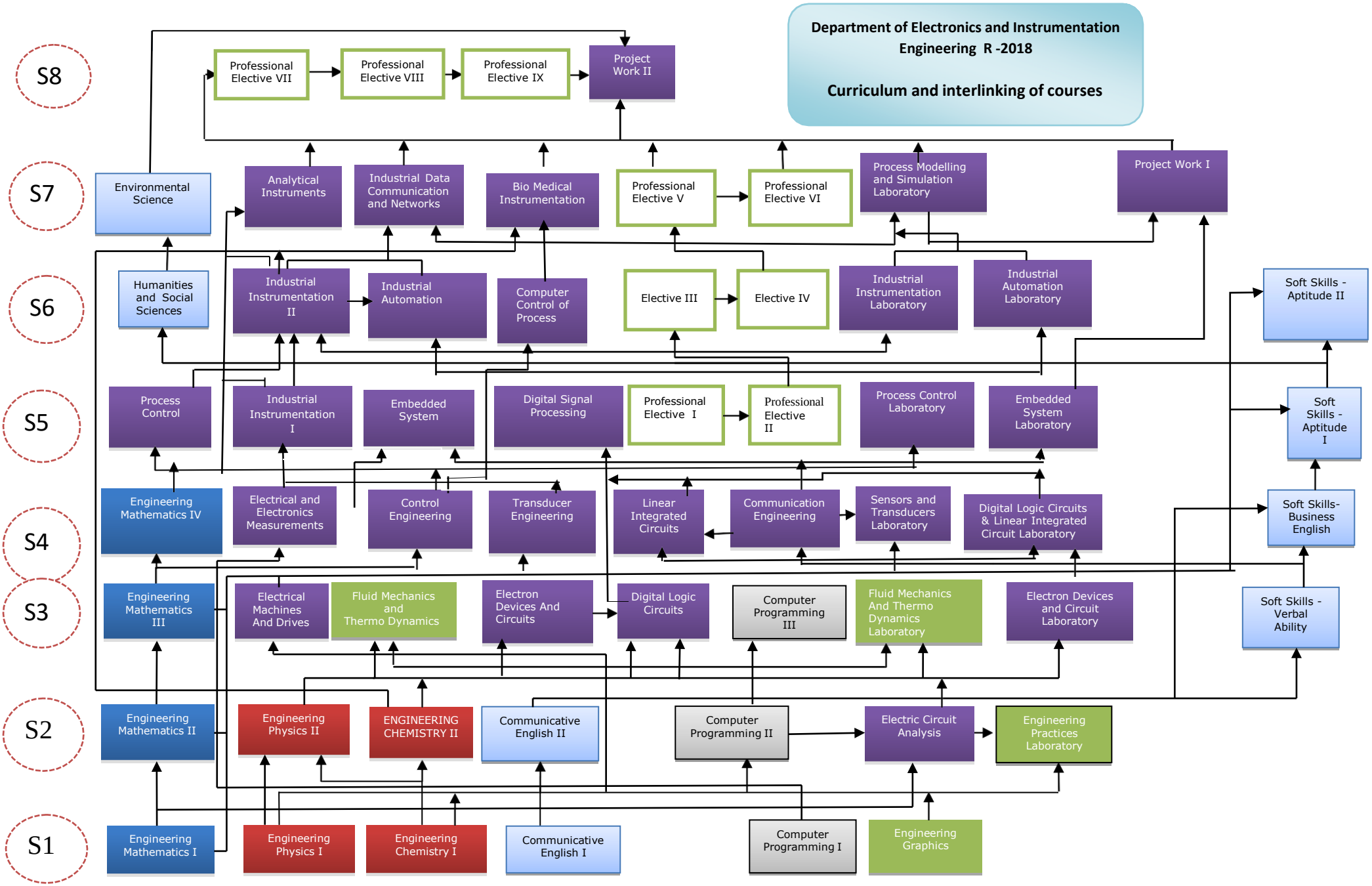
PROGRAMME SPECIFIC OUTCOMES (PSOS)

m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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	X
PEO2	X	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.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING
Minimum Credits to be Earned : 170

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EI101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18EI102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18EI103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18EI104	COMPUTER PROGRAMMING I	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18EI106	ENGINEERING GRAPHICS	1	0	4	3	5	100	0	100	ES
Total		**11**	**1**	**12**	**18**	**24**	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EI201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18EI202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18EI203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18EI204	ELECTRIC CIRCUIT ANALYSIS	3	1	0	4	4	50	50	100	ES
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18EI206	COMPUTER PROGRAMMNG II	2	0	2	3	4	50	50	100	ES
18EI207	ENGINEERING PRACTICES LABORATORY	0	0	4	2	4	100	0	100	ES
Total		**13**	**2**	**12**	**21**	**27**	-	-	-	-

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EI301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18EI302	ELECTRICAL MACHINES AND DRIVES	2	0	2	3	4	50	50	100	ES
18EI303	FLUID MECHANICS AND THERMO DYNAMICS	3	1	0	4	4	50	50	100	ES
18EI304	ELECTRON DEVICES AND CIRCUITS	3	1	0	4	4	50	50	100	ES
18EI305	DIGITAL LOGIC CIRCUITS	3	1	0	4	4	50	50	100	PC
18EI306	COMPUTER PROGRAMMING III	2	0	2	3	4	50	50	100	ES
18EI307	ELECTRON DEVICES AND CIRCUIT LABORATORY	0	0	2	1	2	100	0	100	ES
18EI308	FLUID MECHANICS AND THERMO DYNAMICS LABORATORY	0	0	2	1	2	100	0	100	ES
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**16**	**4**	**10**	**24**	**30**	**-**	**-**	**-**	**-**
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EI401	ENGINEERING MATHEMATICS IV	3	1	0	4	4	50	50	100	BS
18EI402	ELECTRICAL AND ELECTRONIC MEASUREMENTS	3	0	0	3	3	50	50	100	PC
18EI403	CONTROL ENGINEERING	3	0	2	4	5	50	50	100	PC
18EI404	TRANSDUCER ENGINEERING	3	0	0	3	3	50	50	100	PC
18EI405	LINEAR INTEGRATED CIRCUITS	3	1	0	4	4	50	50	100	PC
18EI406	COMMUNICATION ENGINEERING	3	0	2	4	5	50	50	100	PC
18EI407	DIGITAL LOGIC CIRCUITS & LINEAR INTEGRATED CIRCUITS LABORATORY	0	0	2	1	2	100	0	100	PC
18EI408	SENSORS AND TRANSDUCER LABORATORY	0	0	2	1	2	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**20**	**2**	**10**	**24**	**32**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EI501	PROCESS CONTROL	3	1	0	4	4	50	50	100	PC
18EI502	INDUSTRIAL INSTRUMENTATION –I	3	0	0	3	3	50	50	100	PC
18EI503	EMBEDDED SYSTEM	3	1	0	4	4	50	50	100	PC
18EI504	DIGITAL SIGNAL PROCESSING	3	1	0	4	4	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	50	50	100	PE
18EI507	PROCESS CONTROL LABORATORY	0	0	2	1	2	100	0	100	PC
18EI508	EMBEDDED SYSTEM LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**3**	**6**	**23**	**27**	**-**	**-**	**-**	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HSS
18EI602	INDUSTRIAL INSTRUMENTATION –II	3	0	0	3	3	50	50	100	PC
18EI603	INDUSTRIAL AUTOMATION	3	1	0	4	4	50	50	100	PC
18EI604	COMPUTER CONTROL OF PROCESS	3	1	0	4	4	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	50	50	100	PE
18EI607	INDUSTRIAL INSTRUMENTATION LABORATORY	0	0	2	1	2	100	0	100	PC
18EI608	INDUSTRIAL AUTOMATION LABORATORY	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**2**	**6**	**21**	**25**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	100	0	100	HSS
18EI702	ANALYTICAL INSTRUMENTS	3	0	0	3	3	50	50	100	PC
18EI703	INDUSTRIAL DATA COMMUNICATION AND NETWORKS	3	0	0	3	3	50	50	100	PC
18EI704	BIO MEDICAL INSTRUMENTATION	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	50	50	100	PE
18EI707	PROCESS MODELING AND SIMULATION LABORATORY	0	0	2	1	2	100	0	100	PC
18EI708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**17**	**0**	**8**	**21**	**25**	**-**	**-**	**-**	**-**
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	50	50	100	PE
18EI804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**9**	**0**	**18**	**18**	**27**	**-**	**-**	**-**	**-**

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
`18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
15GE0P1	NANOMATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
15GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
15GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	50	50	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	50	50	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	50	50	100	BS
ENTREPRENEURSHIP ELECTIVES										
18GE0E1	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	50	50	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	50	50	100	PE
DISCIPLINE ELECTIVES										
18EI001	AIRCRAFT INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EI002	FIBER OPTICS AND LASER BASED	3	0	0	3	3	50	50	100	PE

	INSTRUMENTATION									
18EI003	INSTRUMENTATION SYSTEM DESIGN	3	0	0	3	3	50	50	100	PE
18EI004	STANDARDS AND CALIBRATION	3	0	0	3	3	50	50	100	PE
18EI005	DATA COMMUNICATION AND NETWORKS	3	0	0	3	3	50	50	100	PE
18EI006	POWER ELECTRONICS AND DRIVES	3	0	0	3	3	50	50	100	PE
18EI007	HYDRAULICS AND PNEUMATICS	3	0	0	3	3	50	50	100	PE
18EI008	MICRO ELECTRO MECHANICAL SYSTEM	3	0	0	3	3	50	50	100	PE
18EI009	DIGITAL CONTROL SYSTEM	3	0	0	3	3	50	50	100	PE
18EI010	ADVANCED PROCESS CONTROL	3	0	0	3	3	50	50	100	PE
18EI011	CHEMICAL PROCESS SYSTEMS	3	0	0	3	3	50	50	100	PE
18EI012	NEURAL NETWORKS AND FUZZY LOGIC	3	0	0	3	3	50	50	100	PE
18EI013	REAL TIME EMBEDDED SYSTEM	3	0	0	3	3	50	50	100	PE
18EI014	INDUSTRIAL ROBOTICS	3	0	0	3	3	50	50	100	PE
18EI015	BUILDING AUTOMATION	3	0	0	3	3	50	50	100	PE
18EI016	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	3	0	0	3	3	50	50	100	PE
18EI017	POWER PLANT INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EI018	INSTRUMENTATION IN AGRICULTURE AND FOOD PROCESSING INDUSTRIES	3	0	0	3	3	50	50	100	PE
18EI019	INSTRUMENTATION AND CONTROL FOR PROCESS INDUSTRIES	3	0	0	3	3	50	50	100	PE
18EI020	SMART AND WIRELESS INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EI021	VIRTUAL INSTRUMENTATION	2	0	2	3	4	50	50	100	PE
18EI022	INTERNET OF THINGS	3	0	0	3	3	50	50	100	PE
18EI023	SYSTEM IDENTIFICATION	3	0	0	3	3	50	50	100	PE
18EI024	DEEP LEARNING	3	0	0	3	3	50	50	100	PE
18EI025	DIGITAL IMAGE PROCESSING	3	0	0	3	3	50	50	100	PE
18EI026	ENVIRONMENTAL INSTRUMENTATION	3	0	0	3	3	50	50	100	PE

OPEN ELECTIVES										
18EI0YA	PROGRAMMABLE LOGIC CONTROLLER	3	0	0	3	3	50	50	100	OE
18EI0YB	SENSOR TECHNOLOGY	3	0	0	3	3	50	50	100	OE
18EI0YC	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	3	0	0	3	3	50	50	100	OE
18EI0YD	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	50	50	100	OE
ONE CREDIT COURSES										
18EI0XA	VIRTUAL INSTRUMENTATION IN INDUSTRIAL AUTOMATION	1	0	0	1	1	50	50	100	OC
18EI0XB	CALIBRATION TECHNIQUES	1	0	0	1	1	50	50	100	OC
18EI0XC	FACTORY AUTOMATION	1	0	0	1	1	50	50	100	OC
18EI0XD	INDUSTRIAL SAFETY STANDARDS FOR INSTRUMENTATION PRODUCTS	1	0	0	1	1	50	50	100	OC
18EI0XE	PIPING AND INSTRUMENTATION	1	0	0	1	1	50	50	100	OC
18EI0XF	VFD BASED INDUSTRIAL APPLICATIONS	1	0	0	1	1	50	50	100	OC
18EI0XG	SAFETY INSTRUMENT SYSTEM DESIGN	1	0	0	1	1	50	50	100	OC
ADDITIONAL ONE CREDIT COURSES										
18GE0XA	ETYMOLOGY	1	0	0	1	1	50	50	100	-
18GE0XB	GENERAL PSYCHOLOGY	1	0	0	1	1	50	50	100	-
18GE0XC	NEURO BEHAVIOURAL SCIENCE	1	0	0	1	1	50	50	100	-
18GE0XD	VISUAL MEDIA AND FILM MAKING	1	0	0	1	1	50	50	100	-
18GE0XE	YOGA FOR HUMAN EXCELLANCE	1	0	0	1	1	50	50	100	-
18GE0XF	VEDIC MATHEMATICS	1	0	0	1	1	50	50	100	-
18GE0XG	ABNORMAL PSYCHOLOGY	1	0	0	1	1	50	50	100	-
18GE0XH	YOGA FOR ENERGETIC LIFE	1	0	0	1	1	50	50	100	-
18GE0XI	BLOG WRITING	1	0	0	1	1	50	50	100	-
18GE0XJ	INTERPERSONAL SKILLS	1	0	0	1	1	50	50	100	-

18GE0XK	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	1	0	0	1	1	50	50	100	-
18GE0XL	NATIONAL CADET CORPS	1	0	0	1	1	50	50	100	-
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	1	0	0	1	1	50	50	100	-
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	1	0	0	1	1	50	50	100	-
18GE0XO	SOCIAL PSYCHOLOGY	1	0	0	1	1	50	50	100	-
18GE0XP	FM RADIO BROADCASTING TECHNOLOGY	1	0	0	1	1	50	50	100	-
VALUE ADDED COURSES										
18EIV01	C PROGRAMMING FOR INSTRUMENTATION									

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	10	10	4	4	0	0	0	0	28	16.47	15%	20%
2	ES	6	9	16	0	0	0	0	0	31	18.24	15%	20%
3	HSS	2	2	0	0	0	2	2	0	8	4.71	5%	10%
4	PC	0	0	4	20	17	13	10	0	64	37.65	30%	40%
5	PE	0	0	0	0	6	6	6	9	27	15.88	15%	20%
6	EEC	0	0	0	0	0	0	3	9	12	7.06	5%	10%
Total		18	21	24	24	23	21	21	18	170	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

18EI101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering 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.
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.

Course Outcomes (COs)

1. Apply the electrochemical concepts of cell construction and double layer formation to determine the electrode potential of the given metal.
2. Apply the mechanisms of potentiometric, conductometric and amperometric sensors in medical diagnostics and environmental protection.
3. Apply the chemically modified electrode using microfabrication technique for electrochemical sensors
4. Outline the procedure of nanomaterial preparation and their applications in electrochemical sensors
5. Analyze the two mechanisms of corrosion to identify effective corrosion protection methods on metallic objects.

Articulation Matrix

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

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices: Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability,

rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L-Hopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem

FURTHER READING

Quadratic forms -Reduction of a quadratic form to a canonical form - Application of conic sections, quadratic surfaces - discrete dynamical systems - Triple integral in polar coordinates-Formation of Bus Admittance Matrices. Applications of mass spring system in ordinary differential equations of higher order.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015.
3. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995
5. Ayres F Jr and Mendelson E, Schaums Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.

18EI102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

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

m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Apply the Newton's three laws of motion to solve the real world problems involving elevator, at wood machine and acceleration of objects
2. Differentiate the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Analyse the electric and magnetic elements using the fundamental laws and properties of electricity and magnetism.
4. Justify the characteristics of mirrors, lenses, microscopes and diffraction gratings using the concepts of physical and geometrical optics
5. Conclude the wave and particle nature of matter with special theory of relativity and quantum physics

Articulation Matrix

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

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight; Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations.

Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem - determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snells law - dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses - compound microscope - human eye. Conditions of interference - Youngs double slit experiment - intensity distribution of interference - phase change due to reflection - diffraction - narrow slit

diffraction - single slit and two slit - intensity distribution - diffraction grating - applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Meldes apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012

18EI103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Recall the terminologies of electrochemistry and apply it to find the electrode potential
- Explain the sensing mechanism using electrodes in various instruments
- Compare the efficiency of modified electrode for their applications in sensors

- interpret the concept of nanochemistry and their applications in sensors
- outline the fundamentals of corrosion, its types and protection methods

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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Apply the electrochemical concepts of cell construction and double layer formation to determine the electrode potential of the given metal.
2. Apply the mechanisms of potentiometric, conductometric and amperometric sensors in medical diagnostics and environmental protection.
3. Apply the chemically modified electrode using microfabrication technique for electrochemical sensors
4. Outline the procedure of nanomaterial preparation and their applications in electrochemical sensors
5. Analyze the two mechanisms of corrosion to identify effective corrosion protection methods on metallic objects.

Articulation Matrix

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

UNIT I **7 Hours**

ELECTROCHEMISTRY

Electrodes- types of electrodes. Cells- types - applications - gas sensing electrodes - applications.

UNIT II **6 Hours**

SENSORS

Introduction - basic concepts - mechanism - applications of potentiometric, conductometric and amperometric based sensors.

UNIT III **5 Hours**

MODIFIED ELECTRODE FOR SENSORS

Comparison of electrodes to chemically modified electrode for sensors - conversion methods - microfabrication techniques for sensors.

UNIT IV **5 Hours**

NANO MATERIALS FOR SENSORS

Nano materials: Classification - properties - applications. Advantages over macromolecules - synthesis and properties and applications of nanomaterials based sensors.

UNIT V **7 Hours**

CORROSION PROTECTION

Corrosion - types- corrosion control methods: Electroplating (copper) - electroless plating (nickel) -

applications in PCB.

FURTHER READING

Application of nanotechnology for electrical engineers. Electrical insulation polymers. Contact materials for electrical engineering applications.

1 **4 Hours**

EXPERIMENT 1

Determination of strength of HCl in a given solution using H ion sensing electrode

2 **8 Hours**

EXPERIMENT 2

i) Determination of strength of mineral acid by conductometric based sensor electrodes
ii) Determination of strength of mixture of acids (Hydrochloric acid and acetic acid) by conductometric titration.

3 **4 Hours**

EXPERIMENT 3

Estimation of iron in the given sample by potentiometric method using saturated calomel electrode

4 **5 Hours**

EXPERIMENT 4

Preparation of Cadmium sulfide nano crystals using thiourea

5 **5 Hours**

EXPERIMENT 5

Synthesis of metal nanoparticles and their characterization

6 **4 Hours**

EXPERIMENT 6

Estimation of extent of corrosion of given metal by weight loss method

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012.
3. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
4. T. Pradeep, Nano: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill, 2012.
5. Electrochemical Sensors, Biosensors and their Biomedical applications, X.Zhang, H.Zu,J. Wang, Elsevier Science and Technology Books, 2008
6. Microfabrication Techniques for Chemical/Biosensors, proceedings of the IEEE, vol. 91, No. 6, June 2003.

18EI104 COMPUTER PROGRAMMING I 2 0 2 3

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. 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.
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.
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.
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

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	2	2	1	-	3	-	-	-	-	-	-	1	-	2
2	2	1	-	2	3	-	-	-	-	-	-	1	-	2
3	1	3	2	-	3	-	-	-	-	-	-	2	-	2
4	1	3	-	2	3	-	-	-	2	-	1	2	-	2
5	1	3	2	-	3	-	-	1	2	-	2	2	-	2

UNIT I **6 Hours**

INTRODUCTORY CONCEPTS

Introduction to C- Planning and writing a C program- Operators and Expressions- Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma – Sizeof () - Assignment - Shift operator Precedence and order of evaluation.

UNIT II **6 Hours**

CONTROL STATEMENTS

Decision Making and Branching- Decision Making and Looping -Jump Statements.

UNIT III **6 Hours**

ARRAYS AND STRINGS

Arrays- Introduction, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays. Strings- String handling functions.

UNIT IV **6 Hours**

FUNCTIONS

User Defined Functions- Elements of user defined functions - categories of function - call by value and call by reference - recursion

UNIT V **6 Hours**

STRUCTURES AND FILES

Structures - Introduction - defining a structure - declaring structure variables - accessing structure members -File Management in C.

FOR FURTHER READING

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

1 **2 Hours**

EXPERIMENT 1

Implement a C program which include a Fundamental Data types Integer, Float, double and Character.

2 **2 Hours**

EXPERIMENT 2

Implement a C program to perform the Arithmetic Operations using primitive data types.

3 **2 Hours**

EXPERIMENT 3

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

4 **2 Hours**

EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

5 **2 Hours**

EXPERIMENT 5

Implementation of nested if else Conditional Statement.

6 **2 Hours**

EXPERIMENT 6

Implementation of Switch Case Statement.

7 **2 Hours**

EXPERIMENT 7

Implement a C program using for Looping Statement.

8 **2 Hours**

EXPERIMENT 8

Implement a C program using Do-While Looping Statement.

9 **2 Hours**

EXPERIMENT 9

Implement a C program using While Looping Statement.

10 **2 Hours**

EXPERIMENT 10
Implementation of Jumping Statements

11 **2 Hours**

EXPERIMENT 11
Implementation of One Dimensional Array and Two Dimensional Array.

12 **2 Hours**

EXPERIMENT 12
Implement a C program to perform String Manipulation Functions.

13 **2 Hours**

EXPERIMENT 13
Implement a C program using structures and files

14 **2 Hours**

EXPERIMENT 14
Implement a C program which includes four categories of functions and recursive functions.

15 **2 Hours**

EXPERIMENT 15
Implement a C program for Call by value and Call by Reference.

Total: 75 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2017
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

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Apply appropriate grammar and vocabulary that aligns with the expectations of the Competitive exam level.
2. Analyze the general meaning of non-routine letters within your work area, and find key details in

short reports of a predictable nature.

3. Construct straightforward, routine letters of a factual nature, and select relevant information to make notes on routine matters, such as taking or placing orders.
4. Use simple presentations or demonstrations and demonstrate understanding by summarizing key points.
5. Resolve predictable requests from a visitor, outline routine requirements, and offer advice within your job area on simple matters.

Articulation Matrix

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

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2.Our Casuarina Tree - Toru Dutt 3.Palanquin Bearers - Sarojini Naidu 4.The Tyger - William Blake 5.Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18EI106 ENGINEERING GRAPHICS 1 0 4 3

Course Objectives

- Provide knowledge on projection of points and lines.
- Impart skill in drawing projection of simple solids.
- Familiarize creation of orthographic views from isometric projections of simple solids and vice versa.
- Build the proficiency to create two dimensional sketches using software.
- Provide the skill to build three dimensional models and its orthographic views using software.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings..

Course Outcomes (COs)

1. Analyse the projection of points and lines in different quadrants.
2. Construct orthographic projections of simple solids.
3. Create the orthographic and isometric projections of simple solids.
4. Devlop the two dimensional views of engineering components using software.
5. Construct three dimensional models of engineering components and its orthographic views using software

Articulation Matrix

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

UNIT I **6 Hours**

PROJECTION OF POINTS

Practices on lettering, numbering and dimensioning of drawings. Principles of projection, Projection of points in four quadrants, first angle projection of straight lines- parallel, perpendicular and inclined to anyone plane.

UNIT II **6 Hours**

PROJECTION OF SOLIDS

Orthographic projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method.

UNIT III **6 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTION

Conversion of isometric to orthographic projection and vice versa. Perspective projection of simple solids.

UNIT IV **6 Hours**

CREATION OF 2D SKETCHES USING SOFTWARE

Sketch Entities - line, circle, arc, rectangle, slots, polygon, text, snap, and grid. Sketch Tools-fillet, chamfer, offset, convert entities, trim, extend,mirror, move, copy, rotate, scale, stretch, sketch pattern. Geometrical constraints, Dimensioning - smart, horizontal, vertical, ordinate.

UNIT V **6 Hours**

PART MODELING AND DRAFTING USING SOFTWARE

Part Modeling- extrude, cut, revolve, creation of planes, fillet, chamfer, shell, rib, pattern, mirror, loft, draft and swept. Drafting - Converting 3D models to orthographic views with dimensions.

1 **9 Hours**

EXPERIMENT 1

Create 2D sketch of different components used in engineering applications.

2 **9 Hours**

EXPERIMENT 2

Create part model of a component from given isometric drawings.

3 **9 Hours**

EXPERIMENT 3

Create part model of a component from given orthographic views.

4 **9 Hours**

EXPERIMENT 4

Create an assembly model of product from detailed parts drawing.

5 **9 Hours**

EXPERIMENT 5

Create stl file from CAD model, transfer file to 3D printer, setup the machine parameters, build and post process the component using Additive Manufacturing Technology.

Total: 75 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.

18EI201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate 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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Apply the concepts of partial differentiation to evaluate various parameters in signals and systems and characterize maxima and minima of functions for optimization problems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Apply mathematical concepts to construct first-order differential equations derived from real-time phenomena and solve them using appropriate analytical methods
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

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

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoulli s equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

UNIT VI FOR FURTHER READING

Applications in Electromagnetic Fields,Applications in Communication Theory.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18EI202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- Understand the fundamentals of crystal, transport properties of semiconductors and magnetic materials
- Differentiate passive and active components
- Compare different display devices and their functions

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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.

Course Outcomes (COs)

1. Compute the seven types of crystal systems, crystal planes and illustrate unit cell characteristics of SC, BCC, FCC and HCP crystal structures
2. Conclude the characteristics of semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams
3. Differentiate the active and passive components in an electronic circuit and outline the working mechanisms of diodes
4. Analyse the properties of magnetic materials, domain theory of ferromagnetism and the applications of recording and readout process
5. Outline the interaction of electromagnetic radiation with matter and working principle of LED, LCD and OLED display devices

Articulation Matrix

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

3	2	1	-	-	-	-	-	-	2	-	-	-	2	-
4	2	1	-	-	-	-	-	-	2	-	-	-	1	-
5	2	1	-	-	-	-	-	-	2	-	-	-	2	-

UNIT I **6 Hours**

CRYSTAL PHYSICS

Classification of solids - crystal structure - lattice points and space lattice - unit cell and lattice parameters - crystal systems and Bravais lattices - crystallographic planes - Miller indices - interplanar space of lattice planes - anisotropic properties of crystal - unit cell characteristics of SC, BCC, FCC and HCP structures

UNIT II **7 Hours**

SEMICONDUCTING MATERIALS

Band theory of solids - classification of solids - electrical and thermal conductivity - Semiconductors: elemental and compound semiconductor - intrinsic and extrinsic semiconductors - energy band diagram and electrical conduction - variation of Fermi level with temperature and impurity concentration - temperature dependence of carrier concentration in extrinsic semiconductor - Hall effect - determination of Hall coefficient -solar cells.

UNIT III **5 Hours**

PASSIVE AND ACTIVE COMPONENTS

Fundamental definitions - types of resistors, capacitors, inductors and transformers - characteristics of PN junction. Diodes: laser diode - PIN diode - Schottky diode - step recovery diode - tunnel diode - varactor diode - Zener diode

UNIT IV **6 Hours**

MAGNETIC MATERIALS

Basic definitions - origin of magnetic moment - classification of magnetic materials - influence of temperature on magnetic behaviour - domain theory of ferromagnetism - hysteresis of ferromagnetic materials - soft and hard magnetic materials - applications: magnetic recording - giant magneto resistance (GMR) effect

UNIT V **6 Hours**

DISPLAY DEVICES

Electromagnetic radiation - interaction of radiation with solids - classification of optical materials - luminescence - types of luminescence - LED and OLED: principle, construction, working, advantages and disadvantages. LCD: characteristics of liquid crystals - types - phases - twisted nematic display: construction, working, merits and demerits. Comparison of LED, OLED and LCD

1 **5 Hours**

EXPERIMENT 1

Measurement of resistivity of a given material by four probe method

2 **5 Hours**

EXPERIMENT 2

Find the Hall coefficient and carrier concentration of semiconducting material using Hall effect apparatus

3 **5 Hours**

EXPERIMENT 3

Determine the V-I characteristics of a solar cell

4 **5 Hours**

EXPERIMENT 4

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor

5 **5 Hours**

EXPERIMENT 5

Determine the V-I characteristics of P-N diode and Zener diode

6 **5 Hours**

EXPERIMENT 6

Determine the thermal conductivity of a bad conductor by using Lee's disc method

Total: 60 Hours

Reference(s)

1. Balasubramaniam, R. "Callister""s Materials Science and Engineering". Wiley India Pvt.Ltd., 2014
2. Kasap, S.O. "Principles of Electronic Materials and Devices". McGraw-Hill Education,2017.
3. William D. Callister, Jr. & David G. Rethwisch "Fundamentals of Materials Science and Engineering".John Wiley and Sons Incl.,2008.
4. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Alpha Science International Ltd., 2017.
5. Donald A. Neamen. "Semiconductor Physics and Devices", Mc Graw-Hill, 2011
6. Palanisamy P. K. "Physics for electronics and information science". Dipti Press Pvt. Ltd., 2018.

18EI203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- summarize the liquid and gas analysis techniques and its types.
- classify the types of the chromatography and predict their applications
- introduce the concept of spectroscopy and interpret their signals
- outline the basics of nuclear radiation techniques and their instrumentation
- outline the applications of conducting polymers in electronics.

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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.

Course Outcomes (COs)

1. Apply the liquid and gas analysis techniques to measure the chemical and physical properties of liquids and gases in various applications
2. Classify the three types of the chromatography and its role in separation, identification and quantification of components in a mixture.
3. Apply the spectroscopic principles of UV and IR techniques to interpret the peaks from organic compounds used in pharmaceutical and chemical industries.
4. Analyse the NMR and ESR spectroscopic techniques for its use in imaging and material characterization.

5. Analyse the properties of conducting polymers used for data storage devices in electronics.

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	-	-	-	-	-	-	-	-	-	-	3	-
3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
4	2	2	-	-	-	-	-	-	-	-	-	-	3	-
5	2	2	-	-	-	-	-	-	-	-	-	-	1	-

UNIT I **6 Hours**

LIQUID AND GAS ANALYSIS

Dissolved oxygen analyser - sodium analyser - silica analyser - moisture measurement - oxygen analyser - CO monitor - NOx analyser - H2S analyser - dust and smoke measurement - thermal conductivity type - thermal analyser - industrial analysers

UNIT II **6 Hours**

CHROMATOGRAPHY

Chromatography - gas chromatography - detectors - liquid chromatography - applications - High - pressure liquid chromatography - applications

UNIT III **6 Hours**

SPECTROSCOPY

Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. UV visible and IR spectroscopy - principle, instrumentation (block diagram) and applications

UNIT IV **6 Hours**

MAGNETIC AND RADIATION TECHNIQUES

Nuclear radiation - NMR, ESR spectroscopy - applications - nuclear radiation detectors - GM counter - X-ray spectroscopy and diffractometer- applications

UNIT V **6 Hours**

POLYMERS

Polymers- conducting polymers- physical and chemical properties of commercial/electronic polymers and their applications. Polymers in optical media data storage devices

FOR FURTHER READING

i.Document the various batteries with its characteristics/specifications used in mobile phones, automobiles and laptops ii. Maintenance free batteries, battery recycling

1 **4 Hours**

EXPERIMENT 1

Estimation of DO in given water sample by Winkler s method

2 **3 Hours**

EXPERIMENT 2

Preparation of TLC plate and their analysis

3 **3 Hours**

EXPERIMENT 3

Preparation of columns used in column chromatography and analyze the given sample.

4 **4 Hours**

EXPERIMENT 4

Identify the functional groups of a given sample using IR spectroscopy.

5 **4 Hours**

EXPERIMENT 5

Determination of iron (thiocyanate method) in the given solution by spectrophotometric method

6 **4 Hours**

EXPERIMENT 6

Determination of strength in the given dye solution by application UV visible radiation.

7 **4 Hours**

EXPERIMENT 7

Interpretation of structural details based on the given data obtained by XRD.

8 **4 Hours**

EXPERIMENT 8

Determination of molecular weight of given polymer by Ostwald viscometer

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013
2. H.H. Willard, L. L. Merrit, J. A. Dean and F. L. Seattle, Instrumental Methods of Analysis, CBS Publishing Co, New York,2010
3. D. A. Skoog and D. M. West, Principles of Instrumental Analysis, Holt Sounder Publication, Philadelphia, 2007
4. Robert D. Braun, Introduction to Instrumental Analysis, McGraw Hill book Co, New York, 2006
5. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, New Delhi, 2014
6. Douglas A. Skoog, F James Holler and Stanley R. Crouch, Principles of Instrumental analysis, Thomson, Brooks/Cole, Belmont, Canada, 2007.

18EI204 ELECTRIC CIRCUIT ANALYSIS 3 1 0 4

Course Objectives

- To formulate the solution for basic electric circuit problems
- To differentiate single phase and three phase circuits.
- To compute electrical parameters like current, voltage and power using network theorems
- To impart knowledge in resonance and coupled circuits
- To analyze the transient response of RL and RC series circuits and to solve problems in time domain using Laplace Transform

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. 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.

Course Outcomes (COs)

1. Apply fundamental electrical laws and techniques to find the unknown in the basic DC electric circuits.
2. Analyse the basic RLC circuits with AC sinusoidal signal by applying the concepts of impedance, admittance, and phasor relationships
3. Apply network theorems, along with Star-Delta transformations, to simplify and analyze complex electrical circuits
4. Analyze resonant circuits to determine bandwidth, Q factor, and resonance conditions, and evaluate coupled circuits for practical applications.
5. Analyze the transient response of RL and RC series circuits for the step and ramp inputs, and evaluate the impact of time constant, rise time, and fall time on circuit behavior.

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	2	-	-	-	-	-	-	-	-	-	1	1	-
3	3	2	2	-	-	-	-	-	-	-	-	1	1	-
4	3	2	2	-	-	-	-	-	-	-	-	1	1	-
5	3	2	2	-	-	-	-	-	-	-	-	1	1	-

UNIT I **8 Hours**

DC CIRCUITS

Electric circuit components - 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 - Mesh loop current method - Nodal voltage method

UNIT II **9 Hours**

AC CIRCUITS

Types of waveforms - Advantages of Sinusoidal waveform - Average Value and RMS Value - Form factor and Peak factor - V-I relationships between R, L and C - Phasor relation in pure resistor, inductor and capacitor - Power and power factor - Concepts of impedance and admittance - Analysis of simple circuits - Three phase AC waveform - Phase sequence - Advantages of three phase circuits

UNIT III **10 Hours**

NETWORK THEOREMS AND ITS APPLICATIONS

Super position theorem - Thevenins theorem - Nortons theorem - Maximum power transfer theorem - Star Delta Transformations

UNIT IV **10 Hours**

RESONANCE

Series resonant circuits - Bandwidth of an RLC circuit - Q factor and its effect on bandwidth - Parallel resonance -Simple problems on resonance - Applications of resonance - Coupled circuits - Self and mutual inductance - Inductances in series and parallel - Mutual and leakage flux - Coefficient of coupling

UNIT V **8 Hours**

TRANSIENTS

Introduction - Transient response of RL & RC series circuits with step and ramp inputs - Time Constant - Rise and fall times

FOR FURTHER READING

Reciprocity theorem, substitution theorem

Reference(s)

1. A. Sudhakar and S. P. Shyam Mohan, Circuits and Network Analysis and Synthesis, Tata McGraw Hill, 2017
2. Charles K.Alexander, Fundamentals of Electric Circuits, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2015
3. William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuit Analysis, Tata McGrawHill Publishing Co Ltd, New Delhi, 2012
4. Ravish R Singh, Electrical Networks, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2012

18EI206 COMPUTER PROGRAMMING II 1 0 4 3

Course Objectives

- Design, write, debug, run C++ and Java Programs.
- Develop console based applications using C++.
- Develop Console and windows applications using Java.

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 public health and safety, and cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including the design of experiments, analysis and interpretation of data, and synthesis of 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.
k. Demonstrate knowledge and understanding of 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 broadest context of technological change.
n. Design, develop, and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS, and other modern controllers for the next level of automation.

Course Outcomes (COs)

1. Design class and objects for real world scenario.
2. Apply Inheritance concept to obtain code reusability.
3. Develope applications to manipulate data from files using functions and streams
4. Develop console applications using Java.
5. Develop GUI application using Java library classes.

Articulation Matrix

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

2	2	2	3	2	3	-	-	-	-	-	-	2	-	2
3	2	2	3	2	3	-	-	2	-	-	-	2	-	2
4	2	2	3	2	3	-	-	-	2	-	2	2	-	2
5	2	2	3	2	3	-	-	2	2	-	2	2	-	2

UNIT I **3 Hours**

CLASSES AND OBJECTS

Overview of OOPs Principles - Introduction to classes & objects - Instantiating and Using Classes with objects - Data Members - Member Functions - this Pointer - Constructor & Destructor - Control Structures - Arrays and Strings in C++ - Static class member

UNIT II **3 Hours**

INHERITANCE

Derived Class and Base Class - Derived Class Constructors - Overriding Member Functions - Public and Private Inheritance - Types of Inheritance: Single, Multi Level, Multiple, Hierarchical and Hybrid - Virtual Base Classes - Abstract Classes.

UNIT III **3 Hours**

FUNCTIONS AND STREAMS

Pointers - this Pointer - Pointers to Objects and Derived Classes - Function Overloading - Operator Overloading - Virtual Function - Friend Function - Static Function - Streams: Stream Classes - Unformatted I/O Operations - Formatted Console I/O Operations

UNIT IV **3 Hours**

JAVA OOPS BASICS

Java Basics - Classes and Objects - Inheritance- Interfaces - Abstract Class - packages - Exception handling- Strings - Type wrappers

UNIT V **3 Hours**

JAVA COLLECTIONS AND IO

Generics - Collections -Java Utility Classes - I/O Classes and Interfaces-Java Database Connectivity- Multithreading- Java swing basics

FOR FURTHER READING

Java swing basics

1 **5 Hours**

EXPERIMENT 1

Introduction to OOP lab (Simple C program) - Classes and Objects

2 **5 Hours**

EXPERIMENT 2

Programs using inheritance

3 **6 Hours**

EXPERIMENT 3

Programs using static polymorphism

4 **6 Hours**

EXPERIMENT 4

Programs on dynamic polymorphism

5 **6 Hours**

EXPERIMENT 5

Programs on operator overloading

6 **6 Hours**

EXPERIMENT 6

Programs on dynamic memory management using new, delete operators

7 **6 Hours**

EXPERIMENT 7

Programs on copy constructor and usage of assignment operator

8 **6 Hours**

EXPERIMENT 8

Programs on exception handling

9 **7 Hours**

EXPERIMENT 9

Programs on generic programming using template function

10 **7 Hours**

EXPERIMENT 10

Programs on file handling

Total: 75 Hours

Reference(s)

1. E Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing, New Delhi, 2011.
2. Robert Lafore, Object Oriented Programming in C++, Galgotia Publication, 2010.
3. Herbert Schildt, Java: The Complete Reference, Eleventh Edition, McGraw-Hill Education,2018.
4. D.T. Editorial Services, Java 8 Programming Black Book, second edition, Dreamtech Press,2015.

18EI207 ENGINEERING PRACTICESLABORATORY

0 0 4 2

Course Objectives

- To measure the electrical and physical parameters using suitable instruments for different application.
- To Construct manual P&ID Diagram for the existing flow control loop.
- To Identify different basic elements of PLC, field Instruments, Controller and communication 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.

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 one's own work, as a member and leader in a team, to manage projects and in

multidisciplinary environments.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Select and use the proper instruments to measure the electrical parameters in AC and DC power circuits
2. Carry-out the procedure for the measurenet mechanical parameters distance, force, touch, vibration and pressure using strain gauge, Bourdon tube based pressure gauge, and differential pressure transmitter
3. Use suitable sensors for measuring the physical parameter temperature, humidity, moisture, turbidity and sound.
4. Construct the P&ID Diagram for the flow control loop.
5. Apply the PLC 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	-	2	1	1	1	2	2	-	1	2	-
2	3	2	1	-	2	1	1	1	2	2	-	1	2	-
3	3	2	1	-	2	1	1	1	2	2	-	1	2	-
4	3	2	1	-	-	1	1	1	2	2	-	1	-	1
5	3	2	1	-	3	1	1	1	2	2	-	1	1	2

1 **6 Hours**

EXPERIMENT 1

(i) Measurement of resistance, capacitance, inductance used in DC power source circuit
(ii) Measurement of voltage, current and power in a DC power source circuit by connecting a load.
(iii) Linear and Nonlinear system identification using resistive and RLC circuit.

2 **6 Hours**

EXPERIMENT 2

(i) Measurement of vibration in a given plateform in terms of frequency and amplitude using vibromenter
(ii) Phase angle measurement in an inductive load (ex: fan, motor) using CRO.

3 **6 Hours**

EXPERIMENT 3

Identification of diode, transistors, IC's and transformer used in CRO, function generator, transmitter and power supply circuit.

4 **6 Hours**

EXPERIMENT 4

(i) Measurement of temperature using thermistor, RTD and Thermocouple.
(ii) Measurement of air pressure using strain gauge and Bourdon tube based pressure gauge.
(iii) Diffrential pressure measurement using differential pressure transmitter in a water tank
(iii) Measurement of level using capacitive and differential pressure transmitter
(iv) Water flow measurement using orifice

5 **6 Hours**

EXPERIMENT 5

(i) Measurement of water turbidity using photoelectric sensor
(ii) Touch measurement using capcitive
(iii) Force measurement using piezoelectric sensor and strain gauge

(iv) Distance measurement using photoelectric and ultrasonic sensors
(v) Velocity/speed measurement using LVDT and tachometer.

6 **6 Hours**

EXPERIMENT 6

(i) Measurement of humidity using Capacitive Relative Humidity (RH) Sensors,
(ii) Soil moisture measurement using conductivity sensor
(iii) Sound measurement using desibal meter and micro phone.

7 **6 Hours**

EXPERIMENT 7

(i) Light/fan ON-OFF using relay switch
(ii) Flow control using motor and solenoid valve.

8 **6 Hours**

EXPERIMENT 8

Wired communication between field instruments and controller (CPU/PC) with RS232, RS485, USB, Ethernet, and Coaxial Cable.

9 **6 Hours**

EXPERIMENT 9

P and I D symbols and diagram for flow control loop.

10 **6 Hours**

EXPERIMENT 10

Identification of PLC parts (SMPS, input device, output device, CPU, relay, fuses communication cables, PLC software and its accessories).

Total: 60 Hours

18EI301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Understand the concepts of Fourier series, Partial differential equations, 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.
- 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d. Conduct investigations of complex problems using research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary

environments.

n. 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. Represent the periodic and aperiodic motions of electrical appliances with the help of Fourier Analysis.
2. Find the position of a moving particle which are depending on more than one parameter, using partial differential equations.
3. Formulate a function in frequency domain for which the function defined in time domain through the techniques of Laplace transforms.
4. 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.
5. Summarize and analyse the properties of the parameters of any electrical process with the help of the optimization techniques.

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	2
3	2	2	1	2	-	-	-	-	-	-	-	-	2	2
4	2	1	1	2	-	-	-	-	-	-	-	-	2	2
5	2	2	1	2	-	-	-	-	-	-	-	-	2	3

UNIT I **10 Hours**

FOURIER ANALYSIS

Fourier series for periodic functions. Orthogonal functions. The Euler coefficients. Fourier transforms. Properties of Fourier transform. Applications of Fourier series and transform analysis.

UNIT II **10 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations. One-dimensional wave equation. Method of separation of variables. DeAlembert s solution of the wave equation. Heat equation. Laplace equation. Telegraph equations. Laplace transform method of solution.

UNIT III **9 Hours**

LAPLACE TRANSFORM

Properties and theorems of Laplace transform. Shifting theorems. Inverse Laplace transform, Convolution. Applications to ordinary differential equations. Applications to linear system analysis.

UNIT IV **8 Hours**

Z - TRANSFORM

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

UNIT V **8 Hours**

OPTIMIZATION TECHNIQUES

Introduction to linear programming model, Mathematical formulation, Graphical Method, Simplex method, Big M method (penalty method).

FOR FURTHER READING

Fast Fourier Analysis, Applications of PDE in heat flow

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. O'Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
3. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
4. Hamdy A. Taha, Operations Research, an Introduction, 10th Edition, Pearson, 2017
5. Kanti Swarup, P. K. Gupta, Man Mohan, Operations Research, 15 th Edition, Sultan Chand & sons, 2007.

18EI302 ELECTRICAL MACHINES AND DRIVES 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 concepts of Electrical Drives
- To know the speed control characteristics of DC motors and Induction motor

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 public health and safety, and 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 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 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 broadest context of technological change.

n. Design, develop, and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS, and other modern controllers for the next level of automation.

Course Outcomes (COs)

1. Analyze the characteristics of DC machines and starters
2. Determine the transformer equivalent circuit parameters
3. Analyze the characteristics of single phase and three phase induction motors
4. Assess the concepts of Electrical Drives and selection of motor and its power rating
5. Examine the speed control characteristics of DC motors and Induction motor

Articulation Matrix

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

UNIT I **6 Hours**

D.C. MACHINES

Constructional details - Principle of operation of D.C. generator - EMF equation - Methods of excitation - Self and separately excited generators - Characteristics of series, shunt and compound generators - Principle of operation of D.C. motor - Back EMF and torque equation - Characteristics of series, shunt and compound motors - Starting of DC motors - Types of starters - Working of three point starter

UNIT II **5 Hours**

TRANSFORMERS

Constructional details - Principle of operation - EMF equation - Transformation ratio - Transformer on no load and Load - Parameters referred to HV/LV windings - Equivalent circuit - Regulation - Load test, open circuit and short circuit tests - Problems on equivalent circuit

UNIT III **6 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 **5 Hours**

ELECTRICAL DRIVES

Electrical Drives: Introduction, Advantages and Types - Selection of Electrical Drives - General Electric Drive System - Parts of Electrical Drives - Applications - Selection of motor and its power rating

UNIT V **8 Hours**

SPEED CONTROL OF MOTORS

Speed control of DC Shunt Motor - Speed control of DC Series Motor - Ward-leonard control system - Speed control of Induction motor - Stepper Motor Drives - Servo Motor Drives - VFD Drives

FOR FURTHER READING

Working principle of Syncro motors and its applications

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
Speed control of DC Series motor

5 **6 Hours**

EXPERIMENT 5
Speed control of Induction motor

Total: 60 Hours

Reference(s)

1. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, 2016
2. B.L.Theraja, Textbook(s) of Electrical Technology, S.Chand publications, 2018
3. S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill publishing company Ltd, 2014
4. Electrical Machines and Drives, Anuradha Publications, 2016
5. A.E.Fitzgerald and Stephen Umans, Electric Machinery, Tata McGraw Hill publishing company Ltd, 2014

18EI303 FLUID MECHANICS AND THERMODYNAMICS

3 1 0 4

Course Objectives

- To enhance the students knowledge on fluid statics, kinematics ,dynamics and hydraulic pumps
- To study the fundamentals and laws of thermodynamics
- To understand the basic concepts of various thermal applications like Internal Combustion engines
- 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.
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 public health and safety, and cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of 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 contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Apply fundamental fluid properties to solve practical fluid statics and kinematics problems
2. Analyze fluid dynamics principles and hydraulic pump performance based on their characteristics and applications

3. Apply thermodynamic laws to evaluate work and heat transfer in open and closed systems
4. Compute the efficiency of Otto, Diesel, and Dual air standard cycles in IC engines
5. Assess the performance of refrigeration and air conditioning systems based on psychrometric processes

Articulation Matrix

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

UNIT I **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 II **9 Hours**

FLUID DYNAMICS AND HYDRAULIC PUMPS

Stream and potential functions - Laminar flow, Turbulent flow - Bernoullis equation - Darcys equation - Pipes in series and parallel - major and minor losses - hydraulic grade line - Classification of pumps - Centrifugal pumps - Reciprocating pumps - Multistage pumps - Specific speed and characteristic curves.

UNIT III **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 - Carnot cycle - Heat engines - Refrigerators and heat pumps

UNIT IV **9 Hours**

INTERNAL COMBUSTION ENGINES AND AIR STANDARD CYCLES

Internal combustion engines - Classification and Working Principle of four stroke and two stroke engines - spark and compression ignition engines - Applications of Internal Combustion engines. Air standard cycles: Otto, diesel and dual cycles - comparison of efficiency.

UNIT V **9 Hours**

REFRIGERATION AND AIR CONDITIONING

Refrigeration - Basic functional difference between refrigeration and air conditioning - Terminologies of refrigeration - refrigerants - Vapour compression cycle: Pressure - Enthalpy and Temperature-Entropy diagram - Saturation cycles. Vapour absorption. Air-conditioning systems - Terminologies of psychrometry - Simple psychometric processes - summer, winter, window and central air conditioning systems - concept of effective temperature, infiltration, internal heat gains, Human comfort charts.

FOR FURTHER READING

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

Total: 60 Hours

Reference(s)

1. R.K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2011
2. R. K. Rajput, A Text book of Fluid Mechanics and Hydraulic Machines, S. Chand and Co. Ltd., 2011
3. B. C. Punmia, Ashok K. Jain and Arun K. Jain, Mechanics of Materials, Laxmi Publications, 2010
4. Mahesh M Rathore , Thermal Engineering ,Tata McGraw Hill, New Delhi, 2011.
5. Stephen R. Turns, Thermodynamics Concepts and Applications, Cambridge University Press, 2006
6. Eastop and McConkey, Applied Thermodynamics and Engineering,Pearson Education Ltd,2009

18EI304 ELECTRON DEVICES AND CIRCUITS 3 1 0 4

Course Objectives

- To illustrate the operation of various semiconductor devices and its applications.
- To analyze the characteristics of BJT and FET.
- To outline 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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop, and realize advanced control schemes in different platforms such as microcontrollers, PLC, SCADA, DCS, and other modern controllers for the next level of automation.

Course Outcomes (COs)

1. Analyse the Voltage and Current characteristics of semiconductor devices and its applications.
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 types of oscillator circuits.
5. Construct the Power amplifier circuits and tuned amplifier circuits using BJT.

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	3	2	2	-	-	-	-	-	-	-	-	1	1
3	3	3	2	2	-	-	-	-	-	-	-	-	1	1
4	4	3	3	2	-	-	-	-	-	-	-	-	1	1
5	5	3	3	2	-	-	-	-	-	-	-	-	1	1

UNIT I **9 Hours**

SEMICONDUCTOR DIODES AND APPLICATIONS

Introduction to Semiconductor Devices, Construction and V-I Characteristics : UJT, SCR, P-N junction Diode as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Inductor

Filters, and Capacitor Filters, Voltage Regulation using Zener Diode.

UNIT II **9 Hours**

BJT BIASING AND MODELING

Principle of operation of PNP and NPN transistors -study of CE, CB and CC configurations and comparison of their characteristics, DC Load line, operating point, various biasing methods for BJT- Design Stability- Thermal run away, BJT Modeling- Determination of h-parameters Analysis of a transistor amplifier circuit using h-parameters.

UNIT III **9 Hours**

FET BIASING AND MODELING

The Junction Field Effect Transistor(JFET)-Pinch-off Voltage - Drain and Transfer characteristics, MOSFET Characteristics in Enhancement and Depletion modes, FET Biasing-Fixed bias, Self bias, Voltage divider bias , JFET 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 connection types, Practical feedback circuits - Theory of sinusoidal oscillators - Phase shift oscillator, Wien bridge oscillator - Colpitt's oscillator, Hartley oscillator, Crystal oscillator.

UNIT V **9 Hours**

DIFFERENTIAL AMPLIFIER AND TUNED AMPLIFIER

Differential amplifiers: Common mode analysis, differential mode analysis, DC analysis, AC analysis. Transformer coupled class A, B amplifiers and class B Push-pull amplifiers. 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: 60 Hours

Reference(s)

1. Jacob. Millman, Christos C. Halkias and Sathyabrata Jit, Electronic Devices and Circuits, Tata McGraw Hill, New Delhi, 2015
2. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory, Pearson Education, Tenth edition, 2012.
3. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
4. Theodre F. Boghert, Electronic Devices & Circuits, Pearson Education, Sixth edition, 2011.
5. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.

18EI305 DIGITAL LOGIC CIRCUITS 3 1 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 public health and safety, and cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of information, to provide valid conclusions.
k. Demonstrate knowledge and understanding of engineering and management principles and apply them to one's own work as a member and leader in a team to manage projects in multidisciplinary environments.
l. 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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.

Course Outcomes (COs)

1. Apply the various number systems for the simplification of circuits using K-maps.
2. Design the combinational logic circuits for given real time problems.
3. Implement the Sequential logic circuits for given application.
4. Apply the state transition and analyse the design of sequential circuit.
5. Analyze the digital system design using PLD for the interpretation of the logic families.

Articulation Matrix

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

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 - Moore and Melay models - Counters,Timers, 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
Applications of Digital Circuits - Real time Digital Clock - Digital counter in industries

Total: 60 Hours

Reference(s)

1. M. Morris Mano, Digital Design with an introduction to the VHDL, Pearson Education, 2013.
2. Comer, Digital Logic & State Machine Design, Oxford, 2012.
3. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
4. Mandal, Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
5. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
6. Thomas L.Floyd, Digital Fundamentals, 11th edition, Pearson Education, 2015.

18EI306 COMPUTER PROGRAMMING III 2 0 2 3

Course Objectives

- Understand the history and basics of python
- Gain knowledge about the different data types and control flow statements
- Impart knowledge about the functions, files, list, set tuples and dictionaries

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 public health and safety, and cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of information, to provide valid conclusions.
f. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.

Course Outcomes (COs)

1. Implement simple python programs using input output operations
2. Develop python programs using expressions and statements
3. Implement python programs using control flow statements and strings
   Apply the concepts of functions and files in python programming
4. Design applications using list, sets, tuples and dictionaries in python

Articulation Matrix

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

UNIT I **6 Hours**
INTRODUCTION

What is Python - History of Python - Features of Python - Simple Program in Python - Commenting in Python - Quotations in Python - Lines and Indentation - Multi-Line Statements - Input Operations - Output Operations.

UNIT II **6 Hours**

DATA, EXPRESSIONS AND STATEMENTS

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **6 Hours**

CONTROL FLOW STATEMENTS AND STRINGS

if statement - if-else statement - if-elif-else statement - Nested if - While loop - for loop - else statement used with loops - break statement - continue - pass statement - Strings: string slices - immutability - string functions and methods - In-built string methods - string formatting operations - string module.

UNIT IV **6 Hours**

FUNCTIONS AND FILES

Functions: return values - parameters - local and global scope - function composition - recursion; Files: Reading and Writing-Format Operators-Filenames and paths.

UNIT V **6 Hours**

LIST, SET AND TUPLES

Lists as arrays - Lists: list operations - list slices - list methods - list loop - mutability - aliasing - cloning lists - list parameters; Set; Tuples: tuple assignment, tuple as return value;

FOR FURTHER READING

Dictionaries: operations and methods.

1 **2 Hours**

EXPERIMENT 1

Program to implement basic operators.

2 **2 Hours**

EXPERIMENT 2

Program for Operator Precedence.

3 **3 Hours**

EXPERIMENT 3

Program to implement the concept of function.

4 **3 Hours**

EXPERIMENT 4

Develop the program for selection statements.

5 **3 Hours**

EXPERIMENT 5

Program to implement looping statements.

6 **2 Hours**

EXPERIMENT 6

Program to implement break and continue statements.

7 **3 Hours**

EXPERIMENT 7

Develop a program to implement the concept of Recursion.

8 **3 Hours**

EXPERIMENT 8

Program to implement string functions.

9 **3 Hours**

EXPERIMENT 9

Implement the concept of list.

10 **3 Hours**

EXPERIMENT 10

Develop a program to implement tuples.

11 **3 Hours**

EXPERIMENT 11

Program to implement set, dictionaries.

Total: 60 Hours

Reference(s)

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python - Revised and updated for Python 3.2", Network Theory Ltd., 2014.
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2015.
4. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2017

18EI307 ELECTRON DEVICES AND CIRCUITLABORATORY

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 public health and safety, and cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of 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 professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for, sustainable development.
j. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
l. 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.
m. Develop and implement embedded system-based applications for real-time solutions.
n. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.

Course Outcomes (COs)

1. Implement voltage regulator and converter circuit for given real time applications
2. Analyze the h-parameters of BJT under CE, CB Configuration.
3. Assess the transfer characteristics of FET to design electronic circuits..
4. Design an oscillator circuit using R, L, C components for the given frequency
5. Design an amplifier circuit using Transistors for the given gain value

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

Design a Half wave and Full wave Rectifier using PN junction diode.

2 **3 Hours**

EXPERIMENT 2

Design a voltage regulator using Zener diode.

3 **3 Hours**

EXPERIMENT 3

Determine h-parameters for a transistor under CE configuration.

4 **3 Hours**

EXPERIMENT 4

Determine h-parameters for a transistor under CB configuration

5 **3 Hours**

EXPERIMENT 5

Determine transcondutance and transresistance of JFET.

6 **3 Hours**

EXPERIMENT 6

Determine transcondutance and transresistance of MOSFET.

7 **3 Hours**

EXPERIMENT 7
Design of audio frequency oscillator.

8 **3 Hours**

EXPERIMENT 8
Design of radio frequency oscillator.

9 **3 Hours**

EXPERIMENT 9
Design a differential amplifier circuit using BJT.

10 **3 Hours**

EXPERIMENT 10
Design a Class A power amplifier using BJT.

Total: 30 Hours

Reference(s)

1. Jacob. Millman, Christos C. Halkias and Sathyabrata Jit, Electronic Devices and Circuits, Third Edition, Tata McGraw Hill, New Delhi, 4th Edition,2015.
2. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory, 11th edition, Pearson Education, 2012
3. Theodre F. Boghert, Electronic Devices & Circuits, Sixth edition, Pearson Education, 2011

18EI308 FLUID MECHANICS AND 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d. Conduct investigations of complex problems using research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of 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 contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional 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 engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary

environments.

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

Course Outcomes (COs)

1. Analyse the fluid properties and their influence on the fundamental laws of fluid mechanics
2. Evaluate the volume flow rates and energy losses in pipe flow systems.
3. Analyze the performance characteristics of pumps based on flow rate and discharge levels
4. Compute valve and port timings of internal combustion engines from experimental data
5. Determine the coefficient of performance (COP) of refrigeration and air-conditioning systems

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

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

2 **3 Hours**

EXPERIMENT 2

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

3 **3 Hours**

EXPERIMENT 3

Determine the coefficient of discharge of given Orifice meter

4 **3 Hours**

EXPERIMENT 4

Determine the coefficient of discharge of given Venturimeter

5 **3 Hours**

EXPERIMENT 5

Determination of friction factor for a given set of pipes

6 **3 Hours**

EXPERIMENT 6

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

7 **3 Hours**

EXPERIMENT 7

Experimental study on port timing diagram of IC engines

8 **3 Hours**

EXPERIMENT 8

Experimental study on valve timing diagram of IC engines

9 **3 Hours**

EXPERIMENT 9

Experimental study on determination of Coefficient of Performance of refrigeration system

10 **3 Hours**

EXPERIMENT 10

Experimental study on determination of Coefficient of Performance of Air-conditioning system

Total: 30 Hours

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To read and understand unabridged text
- To help students become proficient in basic writing skills related to work place communication

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

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

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

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. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for

Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

18EI401 ENGINEERING MATHEMATICS IV 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics of one dimensional random variables.
- Analyze the various data by different numerical and statistical sampling techniques.
- 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. Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena.
2. Analyze the various data by different numerical techniques.
3. Analyze the various collection of data in science / engineering problems using statistical inference techniques.
4. Verify the validity of an argument using propositional and predicate logic and apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction.
5. Apply the concept of error analysis and finite element analysis techniques in their core area.

Articulation Matrix

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

UNIT I **8 Hours**

PROBABILITY THEORY

Probability. Random variables, probability densities and distributions, mean and variance of a distribution. Conditional probability. Bayes theorem. Binomial, Poisson and normal distributions.

UNIT II **10 Hours**

NUMERICAL METHODS

Single and multi-variable nonlinear equations, convergence of fixed point iterations. Least squares approximation, Normal equations. Polynomial interpolation and cubic spline interpolation. Single step methods, Runge-Kutta methods. Multi-step methods. Finite Difference Methods.

UNIT III **10 Hours**

MATHEMATICAL STATISTICS

Sample mean and variance. Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

UNIT IV **7 Hours**

SET THEORY AND GRAPHS

Sets: Relations, Equivalence relations, Functions. Graphs: Graph Isomorphism, connected Graphs, Trees, Shortest path problem.

UNIT V **10 Hours**

FINITE ELEMENT ANALYSIS AND ERROR ANALYSIS

Introduction to finite element methods, solutions to discrete and continuous system mathematical model, Errors, Truncation and round off errors, measurement errors, Chebychev's Polynomial and data filtering.

FOR FURTHER READING

Decision Making Algorithm

Total: 60 Hours

Reference(s)

1. Greenberg Michael D., Advanced Engineering Mathematics, Prentice-Hall International Inc, 1998.
2. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
3. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
4. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
5. Kenneth H Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, Seventh Edition, Seventh Edition, Mc Graw Hill Education India Private Limited, New Delhi, 2013.
6. Klaus-Jurgen Bathe, Finite Element Procedures, Pearson Education, Inc., 2nd edition: fourth printing 2016.

18EI402 ELECTRICAL AND ELECTRONICMEASUREMENTS

3 0 0 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 solve engineering problems. Identify, formulate, and analyze complex engineering problems using principles of mathematics, natural sciences, and engineering sciences.

b. Design solutions for complex engineering problems and system components/processes that meet specified needs while considering public health, safety, cultural, societal, and environmental factors. Conduct investigations using research-based knowledge and methods, including experiment design, data analysis, and synthesis for valid conclusions.

l. Recognize ethical responsibilities and apply professional ethics and norms in engineering practice.

m. Demonstrate knowledge of engineering and management principles, applying them to projects in multidisciplinary environments.

Course Outcomes (COs)

1. Select the appropriate measuring instrument to measure electrical parameters
2. Apply the principles of watt meters and energy meters to measure power and energy in single and three-phase circuits
3. Apply the potentiometers and instrument transformers to measure the high voltage and current
4. Select the bridge circuit techniques for the measurement of resistance and impedance in AC and DC circuits
5. Use the appropriate display and recording device to measure the current,voltage and frequency

Articulation Matrix

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

UNIT I **7 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 **9 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 **9 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- Clamp meters

UNIT IV **12 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 **8 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.

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.

Total: 45 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

18EI403 CONTROL ENGINEERING 3 0 2 4

Course Objectives

- To Study the principles of system modelling, system analysis and feedback control, and use them to design and evaluate feedback control systems with desired performance.
- Control system modelling: modelling of electric and mechanical systems, using differential equations, transfer functions, block diagrams, and state variables.
- Control system analysis: analysis of properties of control systems, such as stability, controllability, tracking, in time and frequency domains.
- Control system design: design of feedback controllers, such as PID, lead and lag compensators to meet desired system performance specifications.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of complex 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 public health, safety, and environmental concerns.
d. Use research-based knowledge and methods, including the design of experiments, data analysis, and synthesis of 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 while understanding their limitations.
i. Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and society at large through reports, design documentation, presentations, and clear instructions.
l. 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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.
n. Design, develop, and realize advanced control schemes in platforms such as microcontrollers, PLC, SCADA, DCS, and other modern controllers for advanced automation.

Course Outcomes (COs)

1. Develop a mathematical model of a physical system and compute the transfer function using Block diagram reduction technique and Signal flow graph.
2. Analyze the performance of first, second order systems and control modes using standard test signals.
3. Analyze the given system using frequency response domain specifications.
4. Investigate the stability of a given system using Routh Hurwitz criterion & Root Locus technique and Design compensator using time domain analysis

5. Develop a mathematical model of a physical system using state variable techniques.

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	-	2	1	1
2	3	2	-	2	3	-	-	-	2	2	-	2	1	2
3	3	2	-	2	3	-	-	-	2	2	-	2	-	2
4	3	2	2	2	3	-	-	-	2	2	-	2	-	3
5	3	2	-	2	3	-	-	-	2	2	-	2	1	1

UNIT I **9 Hours**

MATHEMATICAL MODEL OF PHYSICAL SYSTEMS

Basic elements in control systems - Open and closed loop systems with examples - Mathematical representation of systems - Transfer function - mechanical and electrical systems - AC and DC servomotors - Electrical analogy of mechanical systems - Block diagram reduction techniques - Signal flow graphs.

UNIT II **7 Hours**

TIME DOMAIN ANALYSIS

Time response - Time domain specifications -Types of test input - Time response analysis - I and II order system response - Steady state errors and error constants - Concepts and applications of P, PD, PI and PID - types of control.

UNIT III **10 Hours**

FREQUENCY DOMAIN ANALYSIS

Frequency response - Frequency domain specifications - Polar plot - Bode plot - Nyquist plot - The Nyquist stability criterion - Correlation between frequency domain and time domain specifications.

UNIT IV **12 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 **7 Hours**

STATE VARIABLE ANALYSIS

Concept of state variables - State models for linear and time invariant systems - State transition matrix - controllability - observability.

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.

1 **5 Hours**

EXPERIMENT 1

Modelling of the Servo motor in transfer function and State space

2 **5 Hours**

EXPERIMENT 2

Time response analysis using MATLAB

3 **5 Hours**

EXPERIMENT 3
Frequency response analysis using MATLAB

4 **5 Hours**

EXPERIMENT 4
Stability analysis of LTI systems

5 **5 Hours**

EXPERIMENT 5
Performance analysis of P, PI, PD and PID controllers

6 **5 Hours**

EXPERIMENT 6
Compensator design using MATLAB

Total: 75 Hours

Text Book(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, 2010.
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
6. Norman S. Nise, Control Systems Engineering, 4th edition, New York, John Wiley, 2003. (Indian edition)

18EI404 TRANSDUCER 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 complex 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 public health, safety, and environmental concerns.
d. Use research-based knowledge and methods, including the design of experiments, data analysis, and synthesis of 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 broadest context of technological change.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.
n. Design, develop, and realize advanced control schemes in different platforms such as microcontrollers, PLC, SCADA, DCS, and other modern controllers for the next level of automation.

Course Outcomes (COs)

1. Analyse the errors in measurement and instrumentation systems using static and dynamic characteristics
2. Apply the characteristics of resistive transducer for a given applications
3. Analyze the variable inductive transducers for the meausrement of displacement and pressure

4. Analyze the capacitive transducers for the given applications
5. Apply the 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	2	1	-	-	-	-	-	-	-	1	2	1
2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
3	2	2	-	-	-	-	-	-	-	-	-	2	3	-
4	2	2	-	-	-	-	-	-	-	-	-	2	3	-
5	2	2	1	-	-	-	-	-	-	-	-	2	2	-

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- Dynamic characteristics and order of the systems- Transducers classification

UNIT II **9 Hours**

VARIABLE RESISTANCE TRANSDUCERS

Principles of operation - Construction details -Characteristics of resistance transducers -Resistance potentiometers -Strain gauges -Resistance thermometers -Thermistors - Hot wire anemometer - Piezoresistive sensor

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

UNIT IV **9 Hours**

VARIABLE CAPACITIVE TRANSDUCERS

Variable air gap type - Variable area type - Variable permittivity type - Feedback type capacitance proximity pickup - Capacitor microphone

UNIT V **9 Hours**

OTHER TRANSDUCERS

Piezoelectric transducer- Ultrasonic transducer - Magnetostrictive transducer - Fiber optic transducers -Hall effect transducers -Photoelectric transducers and humidity 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. D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, 2009
3. E.O.Doeblin, Measurement Systems: Applications and Design , 6th Edition, Tata McGraw-Hill Book Co., 2012
4. D. V. S. Murthy,Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2013

5. J. P. Bentley, Principles of Measurement Systems, 4th Edition, Addison Wesley Longman Ltd., UK, 2015

18EI405 LINEAR INTEGRATED CIRCUITS 3 1 0 4

Course Objectives

- To understand the fabrication process of an IC, the characteristics of an Operational amplifier
- To study the characteristics and applications of Op-amp
- To study internal functional blocks and the application of special IC's like Timers, PLL circuits, regulator circuits and converters

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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Analyse Integrated circuits based on size, complexity and fabrication.
2. Design and analyse the various linear application of op-amp.
3. Design a simple filter circuit using Op-amps and differentiate A/D and D/A conversion techniques.
4. Organize the various special ICs used for field applications
5. Design the various types of regulators and amplifiers with its key factors.

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	2	3	-	-	-	-	-	-	-	-	-	2	-
3	3	2	3	-	-	-	-	-	-	-	-	-	2	-
4	3	3	2	-	-	-	-	-	-	-	-	-	2	-
5	3	3	3	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

IC FABRICATION

IC classification, fundamentals of monolithic IC technology, epitaxial growth, masking and etching, Diffusion of Impurities and packaging - Realization of simple monolithic ICs

UNIT II **9 Hours**

CHARACTERISTICS OF OP-AMP

Ideal Op-Amp characteristics - Inverting, Non inverting amplifier- 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, Differentiator, Integrator, First order low pass and high pass filters, V/I & I/V converters, comparators, summer, S/H circuit, D/A converter: R-2R ladder and weighted resistor types - A/D converter: Dual slope, successive approximation and flash type.

UNIT IV **8 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.

UNIT V **8 Hours**

WAVEFORM GENERATORS AND APPLICATION ICS

Schmitt trigger, multivibrators, triangular and sine waveform generators, IC voltage regulators: 78XX-Fixed and LM317-adjustable voltage regulators, LM723 general purpose regulators.

FOR FURTHER READING

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

Total: 60 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

18EI406 COMMUNICATION ENGINEERING 3 0 2 4

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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

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	1	2	2										1	
2	1	2	2										2	
3	1	2	2											
4	1	2	2											
5	1	2	2											

UNIT I **9 Hours**

AMPLITUDE MODULATION

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

UNIT II **9 Hours**

ANGLE MODULATION

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

UNIT III **9 Hours**

DIGITAL MODULATION

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

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 **6 Hours**

EXPERIMENT 1

Amplitude Modulation and Demodulation

2 **6 Hours**

EXPERIMENT 2

Frequency Modulation and Demodulation

3 **6 Hours**

EXPERIMENT 3
Phase Modulation and Demodulation

4 **6 Hours**

EXPERIMENT 4
Pulse Amplitude Modulation and Demodulation

5 **6 Hours**

EXPERIMENT 5
Digital Modulation: ASK, FSK, PSK, QPSK

Total: 75 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

18EI407 DIGITAL LOGIC CIRCUITS AND LINEARINTEGRATED 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.
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 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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Demonstrate the working of computational circuits using logic gates
2. Implement the sequential logic circuits, flip flops and shift registers
3. Implement the monostable and astable multivibrators using NE/SE 555
4. Construct the differentiator, Integrator and converter circuits using Op-Amp
5. Design ADC and DAC circuits using Op-Amp

Articulation Matrix

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

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 **3 Hours**

EXPERIMENT 4

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

5 **3 Hours**

EXPERIMENT 5

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

6 **3 Hours**

EXPERIMENT 6

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

7 **3 Hours**

EXPERIMENT 7

Design and implementation of V to I and I to V converter.

8 **3 Hours**

EXPERIMENT 8

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

9 **3 Hours**

EXPERIMENT 9

Design of 2 bit Analog to Digital Converter

10 **3 Hours**

EXPERIMENT 10

Design of 4 bit Digital to Analog Converter

Total: 30 Hours

18EI408 SENSORS AND TRANSDUCERLABORATORY

0 0 2 1

Course Objectives

- To apply the concepts of transduction, characteristics and response of transducers
- To implement transduction principles and observe the characteristics of various electrical transducers
- To resolve the characteristics of photoelectric and hall effect 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 public health and safety, cultural, societal, and environmental concerns.
d. Use research-based knowledge and research methods, including designing experiments, analyzing and interpreting data, and synthesizing information to provide valid conclusions.
f. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
g. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of sustainable development.
h. Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering practice.
k. Demonstrate knowledge and understanding of engineering and management principles and apply them to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
l. 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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.
n. Design, develop, and realize advanced control schemes in different platforms such as microcontrollers, PLCs, SCADA, DCS, and other modern controllers for advanced automation.

Course Outcomes (COs)

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

Articulation Matrix

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

1 **4 Hours**

EXPERIMENT 1
Measurement of linear displacement and Pressure using inductive transducer

2 **3 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 **2 Hours**

EXPERIMENT 4
Liquid level measurement using capacitive transducer.

5 **4 Hours**

EXPERIMENT 5
Measurement of light intensity using optical transducers

6 **3 Hours**

EXPERIMENT 6
Design of linearization circuit for thermistor

7 **2 Hours**

EXPERIMENT 7
Vibration measurement using Piezo electric accelerometer

8 **3 Hours**

EXPERIMENT 8
Measurement of force using strain gauge and load cell.

9 **4 Hours**

EXPERIMENT 9
Measurement of linear and angular displacement using resistive transducer.

10 **2 Hours**

EXPERIMENT 10
Measurement of speed using digital shaft angle encoder

Total: 30 Hours

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess 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.

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. Apply the knowledge of forest, water, food, mineral and energy resources for sustainable exploitation of natural resources.
2. Analyze the four types of ecosystems and biodiversity, its values and role of professionals in protecting the environment from degradation.
3. Identify the existing environmental challenges related to air, water, soil, noise, thermal pollution and its management plan.
4. Analyze the strategies of solid waste management, water management and climate change mitigation as a goal towards sustainable development.
5. Analyze the impact of population growth and value education on the development of a country.

Articulation Matrix

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

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). Energy resources: renewable (solar, wind, and hydro).

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: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

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) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods Ã¢?? earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

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

FOR FURTHER READING

Human rights:Biomedical waste -Identification of adulterants in food materials

Reference(s)

Total: 30 Hours

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

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

UNIT I **15 Hours**

LISTENING AND READING

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

UNIT II **15 Hours**

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.

18EI501 PROCESS CONTROL 3 1 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 and unit operations 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.
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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Develop mathematical models and analyze the dynamics of first-order and two-tank systems, to design effective control strategies in both continuous and batch industrial applications.
2. Analyze control systems using basic and composite control actions to evaluate their step responses, and implement electronic controllers to achieve effective process regulation.
3. Analyze the various control schemes and obtain optimum controller settings using tuning methods
4. Analyze and select appropriate control valves, actuators, and positioners, including smart positioners, based on valve characteristics, sizing criteria, and considerations for cavitation and flashing, to ensure efficient process control
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	3	2	-	-	-	-	-	-	-	-	1	-	2
2	3	3	2	-	-	-	-	-	-	-	-	1	-	2

3	3	3	2	-	-	-	-	-	-	-	-	1	-	3
4	3	3	2	-	-	-	-	-	-	-	-	1	-	2
5	3	3	2	-	-	-	-	-	-	-	-	1	-	3

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 - degrees of freedom - self-regulation.

UNIT II **11 Hours**

CONTROLLER CHARACTERISTICS

Basic control actions - characteristics and step responses of ON-OFF, multi-position, 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 - smart positioned-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: 60 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. D.R. Coughanowr, Steven E LeBlanc, Process Systems Analysis and Control, McGraw Hill,Singapore, 3rd Edition, 2009.
4. B. Wayne Bequette, Process Control: modelling, Design, and simulation, PHI learning Pvt. Ltd., New Delhi, 2010.
5. Jonathan Love Process Automation Handbook: A Guide to Theory and Practice,Springer,2010.
6. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 30th reprint 2010.

18EI502 INDUSTRIAL INSTRUMENTATION -I 3 0 0 3

Course Objectives

- To provide exposure on various measuring techniques acceleration, vibration, torque, force and density
- To learn the working and application of different types of high pressure and vacuum transducers
- To analyze the various types of 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Examine the construction and applications of Linear and Angular displacement and Velocity transducers.
2. Outline the characteristics and applications of acceleration, vibration, torque, force and density transducers.
3. Organize the characteristics of pressure measurement transducers and select suitable method for a specified application.
4. Select the suitable temperature measuring Instruments for a given application.
5. Examine contact and non-contact type temperature measurement schemes and select an appropriate one for specified application

Articulation Matrix

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

UNIT I **9 Hours**

MEASUREMENT OF LINEAR AND ANGULAR DISPLACEMENT AND VELOCITY

Linear displacement: Linear potentiometer, Single-Coil Linear Variable-Reluctance Sensor, Variable-Differential Reluctance Sensor, LVDT, Eddy Current - Angular displacement: Angular potentiometer,

Variable-Reluctance Tachogenerators, Synchros, RVDT - Linear velocity: LVDT, seismic Instrument, Doppler Shift Angular velocity: Electrical (dc and ac) Tachometer Generator, Rotating Magnet, Optical Sensors, Hall Effect/Wiegand Effect, Gyroscopes

UNIT II **9 Hours**

MEASUREMENT OF ACCELERATION, VIBRATION, TORQUE, FORCE AND DENSITY

Accelerometers and Vibrometer: Piezoelectric, Piezoresistive, Differential-Capacitance, Strain-Gage and Seismic types - Force: Measurement principle, Load cell- sensing elements-stain gauge and Piezoelectric - Torque: Rotating, Magnetostrictive and Angular Displacement type transducers - Densitometers: Displacement and float type, Hydrometers, Hydrostatic and Vibrating or Coriolis types

UNIT III **9 Hours**

PRESSURE MEASUREMENT

High pressure: Mechanical type- bellows, bourdon, helical, diaphragm or capsule- Dead Weight Piston Gauge - Liquid-Sealed types- Visual Manometers, Float Manometers -D/P transmitter - Electrical types - vacuum gauges: Capacitance Manometers - Pirani, Thermocouple and Thermopile vacuum gauges, hot and cold cathode ionization vacuum gauges - McLeod vacuum calibration gauges

UNIT IV **9 Hours**

TEMPERATURE MEASUREMENT I

Definitions and standards : techniques and classifications - bimetallic thermometers, different types of filled in system thermometer - Resistance Temperature Detector (RDT) - Industrial RTD construction requirements - characteristics - signal conditioning - Two-wire, three-wire and four-wire RTDs - 2 wire and 4 wire transmitters -IC temperature sensor - thermistor - Characteristics, measurement methods linearization, thermowell .

UNIT V **9 Hours**

TEMPERATURE MEASUREMENT II

Thermocouples - laws of intermediate temperatures and metals - types of thermocouple - cold junction compensation thermocouple construction - thermocouple output to temperature conversion - Radiation and Infrared Pyrometers: Theoretical relationships- total, narrow band, ratio, optical and IR pyrometers - detectors.

FOR FURTHER READING

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

Total: 45 Hours

Reference(s)

1. Bela G. Liptak, Process Measurement and Analysis, Volume-I, Instrument Engineers' Handbook, fourth edition, CRC press, USA, 2012.
2. John G. Webster, The Measurement, Instrumentation and Sensors Handbook, CRC and IEEE press, USA, 2017.
3. Tony R. Kuphaldt, Lessons In Industrial Instrumentation, Version 2.33, 2019, open-source textbook. (http://openbookproject.net/books/socratic/sinst/book/)
4. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, Second edition, McGraw-Hill Professional, 2018
5. Patranabis D, Principal Of Industrial Instrumentation, Third edition, Tata McGraw-Hill Education Pvt. Ltd., 2010

18EI503 EMBEDDED SYSTEM 3 1 0 4

Course Objectives

- To provide in depth knowledge about embedded processor, its hardware and software
- To understand the embedded system design and their operating system

- To apply knowledge of embedded processor architecture in 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Analyze the architecture and instruction set of the PIC Microcontroller.
2. Apply the architecture and memory management of the ARM Microprocessor.
3. Implement the fundamental concepts of embedded systems and design interfaces for input/output peripherals.
4. Design and simulate real-time embedded system applications for diverse domains.
5. Implement and debug real-time embedded applications on hardware platforms.

Articulation Matrix

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

UNIT I **9 Hours**

PIC MICROCONTROLLER

CPU Architecture and instruction sets: Hardware architecture and pipelining - program memory consideration - register file structure and addressing modes - CISC vs. RISC - CPU Register - Timer and counter - Interrupt - A/D convertors - UART

UNIT II **9 Hours**

ARM MICROCONTROLLER

LPC2148 ARM 7 microcontroller - Features of LPC2148 - Pin diagram of LPC2148 - Architectural overview - Abstraction in hardware design - Memory Interface, Bus Cycle types, Register set, Operational Modes - 3 and 5 Stage Pipeline ARM Organization - ARM Instruction Execution and Implementation.

UNIT III **12 Hours**

EMBEDDED SYSTEM AND I/O INTERFACING AND COMMUNICATION PROTOCOL

Introduction to embedded system - embedded system architecture - classifications of embedded systems - design challenges in embedded systems - processor technology. Interfacing and Communication Protocols Interfacing of LEDs, 7segment LEDs - LCD and Keypad interfacing - A/D converters, stepper motors - SPI - UART - I2C - Bluetooth - Zig-Bee - LoRa.

UNIT IV **8 Hours**

REAL TIME OPERATING SYSTEM

Architecture of the Kernel- Multitasking- Tasks- Context Switches- Kernels- Schedulers- Priorities -

Deadlock - Event Flags- Interrupts - Interrupt Latency-Interrupt Response- Interrupt Recovery - Message Mailboxes- Message Queues - RTOS:Ã‚µCOS

UNIT V **7 Hours**

REAL TIME EMBEDDED SYSTEM

Digital camera -Washing Machine -Automated teller machine - Vending machine -Personal Digital Assistant - Industrial Robots- Food processing industry.

FOR FURTHER READING

Introduction Artificial Intelligence, Internet of Things, Cloud Computing, Advanced embedded systems

Total: 60 Hours

Reference(s)

1. Frank Vahid and Tony Givargis "Embedded System Design: A Unified Hardware/Software Approach", Department of Computer Science and Engineering University of California, Riverside, CA 92521, Draft version, Fall 1999
2. Rajkamal, "Embedded system-Architecture, Programming and Design", Tata McGraw-Hill Education Pvt. Ltd, 2011.
3. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 2013.
4. Peckol, "Embedded system Design", John Wiley &Sons, 2010.
5. http://scp.s-scptuj.mb.edus.s
6. Steve Furber, ARM System on Chip Architecture, Addison Wesley Professional, 2000.

18EI504 DIGITAL SIGNAL PROCESSING 3 1 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 specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental factors.
f. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to professional engineering practice.
g. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
l. Recognize the need for, and have the preparation and ability to engage in, independent and lifelong learning in the context of technological change.
n. Design, develop, and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS, and other modern controllers for the next level of 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	2	-	-	-	-	-	-	-	-	-	1	1	-
2	3	2	-	-	-	-	-	-	-	-	-	1	1	-
3	3	3	3	-	-	1	1	1	-	-	-	1	1	-
4	3	3	2	-	-	1	1	1	-	-	-	1	1	-
5	3	2	-	-	-	-	-	-	-	-	-	1	1	-

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: 60 Hours

Reference(s)

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications, PearsonEducation, 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
6. B.Venkataramani, M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata McGraw Hill, New Delhi, 2013. Website: http://www.analog.com/en/products/processors-dsp/adsp-21xx-processors/adsp-21992.html#product-overview

18EI507 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 public health and safety, and cultural, societal, and environmental concerns.
d. Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of 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 their limitations.
f. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
g. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for, sustainable development.
h. Apply ethical principles and commit to professional ethics, responsibilities, and norms of 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 society at large, including the ability to comprehend and write effective reports, 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 lifelong learning in the broadest context of technological change.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications.
n. Design, develop, and implement advanced control schemes on platforms such as microcontrollers, PLCs, SCADA, DCS, and other modern controllers for the next level of 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.
   Determine a closed loop response for temperature, pressure and flow process station.
3. Design ON/OFF controller for a given system
4. 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	3	2	-	3	3	1	-	-	2	2	-	1	2	3
2	3	2	-	3	3	1	-	-	2	2	-	1	2	3
3	3	2	1	3	3	1	1	1	2	2	-	1	2	3
4	3	2	1	3	3	1	1	1	2	2	-	1	2	3
5	3	2	1	3	3	1	1	1	2	2	-	1	2	3

1 **3 Hours**

EXPERIMENT 1

Open loop response of interacting and non interacting level process.

2 **3 Hours**

EXPERIMENT 2

Analyze the response of different types of control valves.

3 **3 Hours**

EXPERIMENT 3

Tuning of PID controller for first and second order system.

4 **3 Hours**

EXPERIMENT 4

Closed loop control of flow process with and without transportation lag.

5 **3 Hours**

EXPERIMENT 5

Closed loop control of temperature process station.

6 **3 Hours**

EXPERIMENT 6

Closed loop control of pressure process station.

7 **3 Hours**

EXPERIMENT 7

Design of on/off controller for air flow temperature process station.

8 **3 Hours**

EXPERIMENT 8

Implementation of cascade control scheme for level process.

9 **3 Hours**

EXPERIMENT 9

Implementation of single loop PID controller for a pressure process station.

10 **3 Hours**

EXPERIMENT 10

Piping and Instrumentation Diagram for flow or level process using Prodok Software or Smartdraw.

Total: 30 Hours

18EI508 EMBEDDED SYSTEM LABORATORY 0 0 2 1

Course Objectives

- To focus on the embedded system hardware development.
- To implement and simulate the interfacing of I/O devices with embedded boards.
- To analyze performance of different peripherals using different processors.

Programme Outcomes (POs)

a. Apply knowledge of mathematics, science, and engineering fundamentals to solve engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and system components with consideration for public health, safety, and environmental concerns.
d. Conduct investigations using research-based knowledge, design of experiments, data analysis, and interpretation to derive valid conclusions.
e. Apply modern engineering and IT tools, techniques, and resources to engineering problems with an understanding of their limitations.
f. Apply contextual reasoning to assess societal, health, safety, legal, and cultural issues relevant to professional engineering practice.
g. Understand the impact of engineering solutions in societal and environmental contexts and demonstrate knowledge of sustainable development.
h. Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering practice.
i. Function effectively as an individual and as a team member or leader in diverse and multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and society, including report writing, documentation, and presentations.
l. Recognize the need for lifelong learning and engage in independent learning in the context of technological change.
m. Identify and integrate sensors and signal conditioning circuits for measuring industrial physical parameters.

Course Outcomes (COs)

1. Design, develop, and implement interfacing solutions for PIC and ARM microcontroller peripherals
2. Attribute the architectural support for high level language and memory hierarchy.
3. Implement the microprocessor and microcontroller interfacing with I/O peripherals.
4. Implement a wired and wireless network to transfer data.
5. Design a real time embedded application.

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

Implementation of LED control using switch with PIC Microcontroller

2 **3 Hours**

EXPERIMENT 2
Interface LCD with PIC Microcontroller and display "Hello World"

3 **3 Hours**

EXPERIMENT 3
Interfacing KEYPAD with PIC and display value on serial terminal when a key is pressed using UART

4 **3 Hours**

EXPERIMENT 4
Interfacing 7 segment display with PIC microcontroller

5 **3 Hours**

EXPERIMENT 5
Implementation of task management and delays in uC/OS on ARM (LPC2138)

6 **3 Hours**

EXPERIMENT 6
Implement a program for measuring Temperature with ARM (LPC2138)

7 **3 Hours**

EXPERIMENT 7
Multitasking in uC/OS-II RTOS using minimum 3 tasks on ARM (LPC2138)

8 **3 Hours**

EXPERIMENT 8
Interfacing Zigbee with LPC2138 microcontroller

9 **3 Hours**

EXPERIMENT 9
Interface Bluetooth using ARM (LPC2138) to transfer a data over the range 100 meter

10 **3 Hours**

EXPERIMENT 10
Interface of WiFi module using PIC microcontroller for Transmission and Reception of data.

Total: 30 Hours

18GE501 SOFT SKILLS - APTITUDE I 0 0 2 0

Course Objectives

- 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. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage,
2. average and age problems
3. Analyse the profit and loss of real time situations and the relation between ratio, proportion and

variation

4. Apply different techniques to find the distance, speed and time of various moving objects
5. Apply the concepts of coding, sequences and series, data interpretation and critical
6. reasoning to solve real time logical reasoning problems.

Articulation Matrix

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

1 **2 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 **2 Hours**

PERCENTAGE

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 **2 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

4 **2 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 **2 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 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **2 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 **2 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **4 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.

10 **4 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.

11 **4 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12 **2 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

18HS003 PRINCIPLES OF MANAGEMENT **2 0 0 2**

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

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.

d. Conduct investigations of complex problems using research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
h. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
i. Communicate effectively on complex engineering activities with the engineering community and 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.
j. Apply knowledge and understanding of engineering and management principles to project management, finance, and working in multidisciplinary environments as a member and leader in a team.
k. Use the techniques, skills, and modern engineering tools necessary for engineering practice.
l. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

Course Outcomes (COs)

1. Understand the basic concepts of Management.
2. Understand basic knowledge on planning process and its Tools & Techniques
3. Understand management concept of organizing and staffing
4. Understand management concept of directing
5. Understand management concept of controlling

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	-	-	-	-	2	2	-	-	-	-	-	-
3	-	2	-	2	-	2	2	2	2	2	2	-	-	-
4	-	2	-	2	-		-	2	3	3	3	2	2	-
5	-	2	-	2	-	2	2	3	2	2	3	2	2	-

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management -Science or Art - Manager Vs Entrepreneur- types of managers - Managerial roles and skills - Evolution of Management - Scientific, Human Relations, System and Contingency approaches - Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environment -Current Trends and issues in Management.

UNIT II **9 Hours**

PLANNING

Nature and purpose of planning-Planning process-Types of planning - Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**

ORGANISING

Nature and purpose - Formal and informal organization - Organization chart - Organization Structure

and Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design-Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **9 Hours**

DIRECTING

Foundations of individual and group behaviour - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - types and theories of leadership - Communication - Process of communication - Barrier in communication - Effective communication - Communication and IT.

UNIT V **9 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance - Direct and preventive control -Reporting.

Total: 45 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007..
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008

18EI602 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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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	1	1	-	-	1	1	1	-	-	-	2	3	1
2	3	1	1	-	-	1	1	1	-	-	-	2	3	1
3	3	1	1	-	-	1	1	1	-	-	-	2	3	1
4	3	1	1	-	-	1	1	1	-	-	-	2	3	1
5	3	1	1	-	-	1	1	1	-	-	-	2	2	1

UNIT I **8 Hours**

FLOW METERS I

Head type flow meters: Theory and characteristics, Flow rate based on Bernoulli's equation, Orifice: types and Location of pressure taps, limitations - 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 - 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 - moisture measurement in granular materials, solid penetrable materials like wood, web type material - capacitance type - NMR probe for moisture detection - viscosity measurement - 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. Bela G. Liptak, Process Measurement and Analysis, Volume-I, Instrument Engineers' Handbook, fourth edition, CRC press, USA, 2012.
2. John G. Webster, The Measurement, Instrumentation and Sensors Handbook, CRC and IEEE press, USA, 2017.
3. Tony R. Kuphaldt, Lessons In Industrial Instrumentation, Version 2.33, 2019, open-source textbook. (http://openbookproject.net/books/socratic/sinst/book/)
4. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, Second edition, McGraw-Hill Professional, 2018
5. Patranabis D, Principal Of Industrial Instrumentation, Third edition, Tata McGraw-Hill Education Pvt. Ltd., 2010

18EI603 INDUSTRIAL AUTOMATION 3 1 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 Human Machine Interface

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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
m. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Select the appropriate components for executing logical programming in PLC
2. Design PLC, PAC and SCADA programming for given real time applications
3. Compare the Hybrid, Central Computers and Distributed architectures of DCS
4. Implement various hardware interfacing methods with DCS for real time applications
5. Apply various hardware interfacing methods with HMI for real time applications

Articulation Matrix

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

UNIT I **10 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- Instructions in PLC - Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions- PLC Standards IEC 61131-3

UNIT II **8 Hours**

PLC PAC SCADA AND ITS APPLICATIONS

Case studies in PLC: Automatic Traffic Control, Automatic bottle filling System, Automatic level and flow control- Introduction to SCADA - components of SCADA - features of SCADA- Introduction to PAC- Features of PAC

UNIT III **8 Hours**

DISTRIBUTED CONTROL SYSTEM

DCS - Various Architectures: Hybrid, Central Computers, Distributed architectures - Comparison - Local control unit Architectures - Process interfacing issues- Redundant Controller Designs- Process Input/ Output Design 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 - Interfacing of DCS with electrical MCC- Case studies in DCS- Control of Mixing unit in Cement industries- Automatic elevator control.

UNIT V **9 Hours**

HUMAN MACHINE INTERFACE

Human Machine Interface function - Data Handling with HMI- Command line interface- Interface design- Configuration and interfacing with PLC and PC- Communication standards, Ethernet, profibus, RS485

FOR FURTHER READING

Local Area Network - Wireless communication (Ipv6, Ipv4)- Programmable Automation Controller - CAN bus - Analog I/O configuration in PLC programming, Communication Protocol

Total: 60 Hours

Text Book(s)

1. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013

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

18EI604 COMPUTER CONTROL OF PROCESS 3 1 0 4

Course Objectives

- To impart knowledge in the significance and features of design of discrete- time control system.
- To review on the different transform techniques for digital control system design
- To impart knowledge on the techniques to analyse the system performance in the discrete-time domain
- To impart knowledge in discrete state space controller 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 specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

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

g. 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 broadest context of technological change.

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

Course Outcomes (COs)

1. Analyze the response of the digital control system
2. Analyze the performance and stability of a discrete-time control system.
3. Design discrete controllers for continuous-time system using classical methods.
4. Design discrete controllers for continuous-time system using state space technique.
5. Develop discrete state space observer.

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	3	2	2	-	-	-	-	-	-	-	-	2	-	1
3	3	3	3	-	-	1	1	-	-	-	-	2	-	2
4	3	3	3	-	-	1	1	-	-	-	-	2	-	2
5	3	3	3	-	-	1	1	-	-	-	-	2	-	2

UNIT I **9 Hours**

INTRODUCTION TO DIGITAL CONTROL

Configuration of basic digital control system, discrete transfer function, discrete model sampled data systems using z- transform, transfer function model, signal analysis and dynamic response, zero-order hold equivalent, introduction to first-order-hold equivalent, transformation between s-plane, z-plane and w-plane, z-Domain description of sampled continuous-time systems

UNIT II **9 Hours**

CONTROLLER AND OBSERVER DESIGN

Controller Design using transform techniques: Root locus and frequency domain analysis compensator design. Full order and reduced order discrete observer design - Kalman filter and extended Kalman filter design

UNIT III **9 Hours**

STATE SPACE THEORY

Control system analysis using state variable method, vector and matrices, state variable representation, conversion of state variable to transfer function and vice versa, conversion of transfer function to canonical state variable models, system realization, solution of state equations. Solution of discrete-time state equation

UNIT IV **9 Hours**

STATE SPACE DESIGN

Design using state-space methods: controllability and observability, control law design, pole

placement, pole placement design using computer aided control system design (CACSD)

UNIT V **9 Hours**

STABILITY ANALYSIS

Stability analysis and Jury's stability criterion, Lyapunov stability analysis to linear systems and discrete systems, Stability improvement by state feedback

FOR FURTHER READING

Computational methods, Computerized system identification

Total: 60 Hours

Reference(s)

1. M. Gopal, Digital Control and state variable methods, Tata McGraw Hill, 3rd edition., 2008
2. A.Ramakalyan(2004) - Control Engineering- A comprehensive foundation, Vikas Publishing House, New Delhi
3. Dorf, R.C., Bishop, R.H., Modern Control Systems, Prentice Hall, 13th edition, 2016
4. Katsuhiko Ogata, Modern Control Engineering, PHI Learning Private Ltd, 5th Edition, 2010
5. Franklin, G.F., David Powell, J., Emami-Naeini, A., Feedback Control of Dynamic Systems, Prentice Hall, 7th Edition, 2014

18EI607 INDUSTRIAL INSTRUMENTATIONLABORATORY

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.
f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
h. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
i. 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.
j. Demonstrate knowledge and understanding of 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 broadest context of technological change.
m. Apply engineering and scientific principles for innovation, entrepreneurship, and economic development.

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

Course Outcomes (COs)

1. Demonstrate the orifice meter, Venturi meter, Mass flow meter, DPT setup for measuring flow rate and Level of the liquid
2. Compare the pressure gauge and DPT using standard instruments
3. Demonstrate the humidity and vaccum measurement using standard instruments
4. Design the linearization and compensation circuit for thermocouple
5. Predict and nullify the errors in field instruments by integrating the HART Communicator

Articulation Matrix

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

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 **3 Hours**

EXPERIMENT 4

Interfacing of field instruments with controller.

5 **3 Hours**

EXPERIMENT 5

Measurement of humidity and vacuum

6 **3 Hours**

EXPERIMENT 6

Level measurement using Differential pressure transducers

7 **3 Hours**

EXPERIMENT 7

pH measurement and conductivity measurement.

8 **3 Hours**

EXPERIMENT 8

Design of cold Junction compensation circuit for Thermocouple

9 **3 Hours**

EXPERIMENT 9
Linearization of Thermocouple

10 **3 Hours**

EXPERIMENT 10
Calibration of Differential pressure transducers using HART communicator

Total: 30 Hours

18EI608 INDUSTRIAL AUTOMATION LABORATORY

0 0 2 1

Course Objectives

- To obtain practical knowledge in advanced controllers
- To automate linear and nonlinear 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 public health and safety, and cultural, societal, and environmental considerations.
d. Conduct investigations of complex problems using 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. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
h. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
i. 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.
j. Demonstrate knowledge and understanding of 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 broadest context of technological change.
m. Apply engineering and scientific principles for innovation, entrepreneurship, and economic development.
n. Demonstrate knowledge and understanding of the principles of engineering and management and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

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 and to provide solutions for traffic issues

3. Develop Functional Block diagram Program in DCS for controlling Level, Flow, Temperature and Pressure at desired set value by implementing cascade loop structure.
4. Interface and Configure DCS for Sequence control and Interlocking process for real time applications
5. Interface and Configure the AC and DC Motors using HMI

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

Control of Level and flow using PLC

2 **3 Hours**

EXPERIMENT 2

Control of automatic bottle filling system using PLC.

3 **3 Hours**

EXPERIMENT 3

Control of Traffic light system using PLC (Sequence output instruction)

4 **3 Hours**

EXPERIMENT 4

Interfacing of Variable Frequency Drive with PLC

5 **3 Hours**

EXPERIMENT 5

Implementation of PID controller for multi loop process

6 **3 Hours**

EXPERIMENT 6

Control of Pressure and Flow process 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

Control of Temperature process using DCS

10 **3 Hours**

EXPERIMENT 10

Interfacing of AC and DC motors using HMI

Total: 30 Hours

18GE601 SOFT SKILLS-APTITUDE II 0 0 2 0

Course Objectives

- 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. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Apply the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems
3. Analyse objects involving cubes and cuboids in determining the number of sides colored
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

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

1 **2 Hours**

PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2 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.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **2 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time/Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **2 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **4 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **4 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **2 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **2 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, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams,

Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

18HS002 PROFESSIONAL ETHICS INENGINEERING

2 0 0 2

Course Objectives

- To understand Human Values and ethical theory.
- To understand codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

Programme Outcomes (POs)

h. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
k. Use the techniques, skills, and modern engineering tools necessary for engineering practice.
n. 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..

Course Outcomes (COs)

1. Apply human values for sustained lifelong learning.
2. Apply engineering ethics for sustained lifelong learning.
3. Contribute to shape a better character by following ethical actions
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment by established experiments.

Articulation Matrix

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

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 - Kohlbergs and Gilligans 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.

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

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

18EI702 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.

f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
h. 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 broadest context of technological change.

m. Apply engineering and scientific principles for innovation, entrepreneurship, and economic development.

Course Outcomes (COs)

1. Select the appropriate spectrophotometer techniques for analysing concentration of chemical solution
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. Compare three different electrodes and analyzers used for the detection of silicon, sodium and dissolved oxygen using
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	3	-	-	-	-	2	2	1	-	-	-	1	2	-
2	3	2	-	-	-	2	2	1	-	-	-	1	2	-
3	3	-	-	-	-	2	2	1	-	-	-	1	2	-
4	3	-	-	-	-	2	2	1	-	-	-	1	2	-
5	3	-	-	-	-	2	2	1	-	-	-	1	2	-

UNIT I **9 Hours**

COLORIMETRY AND SPECTROPHOTOMETRY

Beer-Lambert's law - colorimeters - basic principle of spectroscopy -Emission and absorption of radiation sources and detectors - UV and visible spectrophotometers - single and double beam instruments - IR spectrophotometers - attenuated total reflectance flame photometers - atomic absorption spectrophotometers - FTIR spectrophotometers - flame emission photometers.-mass spectrophotometers

UNIT II **7 Hours**

CHROMATOGRAPHY

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, biosensors - 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 - nuclear radiation detectors - GM counter - proportional counter - solid state detectors - X-ray spectroscopy - detectors - Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM)

FOR FURTHER READING

Case Study - Bio-analytical technology, Control systems

Total: 45 Hours

Reference(s)

1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd., 2nd edition, 2006.
2. G.W. Ewing, Instrumental Methods of Analysis, McGraw Hill, 2004.
3. Liptak, B.G., Process Measurement and Analysis, CRC Press, 2005.
4. Braun, R.D., Introduction to Instrumental Analysis, McGraw Ã¢?? Hill, Singapore, 2006
5. H.W.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, Instrumental methods of analysis, PHI, 2005
6. James keeler ; Understanding NMR Spectroscopy, Second Edition John Wiley & Sons, 2010

18EI703 INDUSTRIAL DATA COMMUNICATIONAND NETWORKS

3 0 0 3

Course Objectives

- To understand the concept of Data communication and networks and its standards.
- To explain the function of various protocols
- To explore the network security.

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 specified needs with appropriate consideration for public health and safety, 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 broadest context of technological change.
n. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

Course Outcomes (COs)

1. Apply the basics of Data communications to model the networks
2. Analyze the significance of different industrial networks
3. Analyze the architecture of HART and Field bus protocol for the induatrial applications.
4. Compare Modbus and Profibus protocols.
5. Analyze the industrial network threats and propose appropriate solution.

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	1	-	-	-	-	-	-	-	-	1	-	2
3	3	2	1	-	-	-	-	-	-	-	-	1	-	2
4	3	2	1	-	-	-	-	-	-	-	-	1	-	2
5	3	2	1	-	-	-	-	-	-	-	-	1	-	2

UNIT I **9 Hours**

FUNDAMENTALS OF DATA COMMUNICATION AND NETWORKS

Data communications - Protocols and standards-Network devices and Topology- Open System

Interconnection model of ISO- Data link control protocol- Media Access protocol-TCP/IP.

UNIT II **9 Hours**

INDUSTRIAL NETWORKS

Industrial Ethernet - DeviceNet: Architecture-Physical layer- Data link layer- Actuator Sensor (AS) interface - CAN bus: Architecture-Data handling-message frame.

UNIT III **9 Hours**

HART AND FIELD BUS

HART communication protocol - HART networks - HART commands - HART multidrop mode- HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability

UNIT IV **9 Hours**

MODBUS AND PROFIBUS

MODBUS protocol structure - function codes- troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - Data Highway.

UNIT V **9 Hours**

NETWORK SECURITY AND CRYPTOGRAPHY

Network security: Security services, Cryptography: Symmetric key cryptography, Security in the Internet: IP Security & Firewalls.

FOR FURTHER READING

HART and smart instrumentation HART protocol,Physical layer, Data link layer and its benefits - Troubleshooting of HART

Total: 45 Hours

Text Book(s)

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and TroubleshootingÃƒ???Ãƒ??Ãƒ?Ã‚¢?? Newnes Publication, Elsevier First Edition, 2004

Reference(s)

1. William Buchanan, Computer Buses, CRC Press, 2000.
2. Behrouz Forouzan ,Data Communications & Networking ,3RD edition, Tata McGrawhill,2006
3. W.Stallings, Data & Computer Communications, PHI, 9th edition, 2011
4. W.Stallings, Cryptography & Network Security, Pearson, 5th edition, 2011

18EI704 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, diagnostic and therapeutic 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and

environmental considerations.
f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
h. 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 broadest context of technological change.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
n. 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 human physiology and characterize the different transducers to measure its parameters
2. Outline the various Electro physiological and blood flow measurements
3. Examine the techniques for heart, lung and blood pressure measurements
4. Outline the techniques used in medical image analysis and biotelemetry
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	2	2	1	-	-	1	1	1	-	-	-	1	2	-
2	2	2	1	-	-	2	1	1	-	-	-	1	2	1
3	2	2	1	-	-	3	1	2	-	-	-	1	2	1
4	3	2	1	-	-	3	1	2	-	-	-	1	2	1
5	3	2	1	-	-	3	1	2	-	-	-	1	2	1

UNIT I **10 Hours**

HUMAN PHYSIOLOGY AND BIO POTENTIAL ELECTRODES

Cell and their structures - action and resting potential - nervous system: functional organization of the nervous system, structure of nervous system, neurons, synapse -transmitters and neural communication - cardiovascular system- Physiology of heart and lungs - Circulation and respiration - Electrodes - Micro, needle and surface electrodes - electrical safety - grounding and isolation

UNIT II **9 Hours**

ELECTRO-PHYSIOLOGICAL MEASUREMENT

Basic components of a biomedical system - Amplifiers - Preamplifiers, differential amplifiers, chopper amplifiers - Isolation amplifier - Bioamplifier circuits - Transducer - Selection criteria Einthoven triangle - ECG - EEG - EMG - Lead systems and recording methods - Typical waveforms

UNIT III **9 Hours**

NON - ELECTRICAL PARAMETER MEASUREMENTS

Measurement of blood pressure - Sphygmomanometer - Phonocardiogram - Body Plethysmography - pH of blood - Pulse oximeter - Spirometry

UNIT IV **8 Hours**

MEDICAL IMAGING PARAMETER MEASUREMENTS

X- RAY machine - Computer Tomography - Magnetic Resonance Imaging system - Ultrasonography - Endoscopy - Bio-Telemetry

UNIT V **9 Hours**

DIAGNOSTIC AND THERAPEUTIC DEVICES

Cardiac Pacemakers - Defibrillators - Ventilators- Heart Lung machine - Dialyser- Diathermy - Neurostimulator - Elements of audio and visual aids

FOR FURTHER READING

Case Study - Noninvasive Glucose Estimation, Medical Disasters

Total: 45 Hours

Reference(s)

1. R.S.Khandpur, Hand Book of Bio-Medical instrumentation, Tata McGraw Hill publishing company Ltd., 2016
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. E. W. Golding and F. C. Widdis, Electrical measurements and measuring instruments, Ed.5, Pitman Publishing Ltd., London, 1963
5. J. A. Edminister, Theory and problems of electric circuits, Schaums outlineseries, McGraw-Hill, 1991
6. Introduction to Biomedical Technology by J. J. Karr & J. M. Brown, Pearson Publication

18EI707 PROCESS MODELING AND SIMULATION LABORATORY

0 0 2 1

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.
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Identify the given system model and simulate its output response using MATLAB
2. Design conventional PID and fuzzy based controller for given system
3. Design Model (IMC and MPC) based controller and Digital controller for given system
4. Identify the DC motor, cruise system model and design suitable controller
5. Design digital controller for industrial storage tank systems

Articulation Matrix

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

5	3	2	2	3	3	-	-	-	2	2	-	1	-	3

1 **2 Hours**

EXPERIMENT 1

Simulation of Lumped and Distributed Parameter Systems

2 **4 Hours**

EXPERIMENT 2

System Identification of given systems using Parametric Methods

3 **3 Hours**

EXPERIMENT 3

Design of Digital P I D controller for given process model

4 **3 Hours**

EXPERIMENT 4

Digital controller design using dead-beat and dalhins algorithm

5 **3 Hours**

EXPERIMENT 5

Design of Fuzzy controller for given process

6 **3 Hours**

EXPERIMENT 6

Design of IMC control scheme for given process

7 **3 Hours**

EXPERIMENT 7

Design of MPC controller for given process

8 **3 Hours**

EXPERIMENT 8

Modeling and control of DC motor speed and position

9 **3 Hours**

EXPERIMENT 9

Modeling and control of cruise (vehicle speed) system

10 **3 Hours**

EXPERIMENT 10

Modeling and digital controller design for four tank system

Total: 30 Hours

18EI708 PROJECT WORK 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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Develop the solutions for real world problems
2. Develop the technical ideas, strategies and methodologies to solve the real world problems
3. Apply 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	2	2	-	2	1	-	3	-	-	-	3	1
2	2	2	2	3	-	2	-	-	3	-	2	2	2	1
3	-	-	3	2	2	-	1	2	3	-	2	2	3	2
4	-	1	-	2	3	2	2	2	3	-	3	-	1	3
5	-	-	-	-	-	-	-	-	3	3	2	2	1	3

Total: 45 Hours

18EI804 PROJECT WORK II 0 0 18 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Develop the solutions for real world problems
2. Develop the technical ideas, strategies and methodologies to solve the real world problems
3. Apply 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	1	3		2					2	2	2	3
3	2		3	2	2			2			2	2	2	3
4		1		2	3	1	2	2					2	3
5									3	3		2	2	3

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

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

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSC01 CHINESE 1 0 2 2

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various 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 Chinese
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics

4. Use basic sentence structures while writing
5. Understand and use 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										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

UNIT 1

Hello1.Initials and Finals of Chinese b,p,m,f,d,,n,l,g,k,h,j,q,x, 2. Tones Four, 3.Chinese Syllables, 4.Tone S

UNIT II **9 Hours**

UNIT 2

Thank you - Initials and Finals of Chinese, The Neutral Tone, Rules of Tone Marking and abbreviation

UNIT III **9 Hours**

UNIT 3

1. What"s your name - In the school; -In the classroom; -In the school The Interrogative Pronoun 2 The Sentence, 3 Interrogative Sentences with

UNIT IV **9 Hours**

UNIT 4

She is my Chinese teacher - In the library- The Interrogative Pronouns - The Structural Particle - The interrogative Particle

UNIT V **9 Hours**

UNIT 5

Her daughter is 20 years old this year - 1.The Interrogative Pronoun - 2. Numbers below 100 - 3.Indicating a Change - The Interrogative Phrase

Total: 45 Hours

18HSF01 FRENCH 1 0 2 2

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

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. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking

4. Read and understand short passages on familiar topics
5. Understand and use 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										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s"appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s"informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l"annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites. Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu Communication - Chercher un logement, d"ecrire son voisin, s"informer sur un logement Lexique - L"habitat, les pieces, l"equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRESON ENVIRONNEMENT

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l"imparfait Communication - Propose quelqu""un de faire quelque chose, raconteur une sortie au passe parler un filmLexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantiteCommunication Accepter et refuse rune invitation, donner des instructions, commander au restaurantLexique Les services et les commerces, les aliments, les ustensiles, argent

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

Total: 45 Hours

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

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
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use 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										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

UNIT 1

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

UNIT 2

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

UNIT 3

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

UNIT 4

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

UNIT 5

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi

- To teach them how to converse in Hindi on simple 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. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

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

UNIT I **9 Hours**

UNIT 1

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

UNIT 2

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

UNIT 3

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**

UNIT 4

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

UNIT 5

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination

- To teach them use 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										2				
2										2				
3										2				
4										2				
5										2				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30

Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse 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. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	2												
4	2	2							2					
5	2	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 -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 physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

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 LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

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, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

18GE0P2 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, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse 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. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
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	1							2					
2	2								2					
3	2	2												
4	2	2							2					
5	2	1							2					

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

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

18GE0P3 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, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse 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. 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	2								2					
3	2	2												
4	2	2							2					
5	2	1							2					

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein"s prediction - Einstein"s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

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.

18GE0C1 CORROSION SCIENCE ANDENGINEERING

3 0 0 3

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply 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.

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. Explain 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					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - 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-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design 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

18GE0C2 ENERGY STORING DEVICES 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.

Course Outcomes (COs)

1. Explain 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. Compare different methods of storing 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	2	1												
2	2						1							
3	1	3												
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 lithium and lead acid battery - 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, and mercuric oxide - 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 - 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. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

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

18GE0C3 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various 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.

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, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsionpolymerization (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: 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 plastics 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

18GE0M1 GRAPH THEORY AND COMBINATORICS

3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer 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.

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

18GE0M2 ALGEBRA AND NUMBER THEORY 3 0 0 3

Course Objectives

- Understand the basic notions of groups, rings, fields which will then be used to solve related problems.
- Examine the key questions in the Theory of Numbers.
- Implement the integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

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. Exemplify the concepts of groups and fields in the areas of Engineering.
2. Classify the different types of fields.
3. Organize the divisibility in number theory in various areas of Engineering.
4. Identify the solution of some kinds of equations.
5. Demonstrate the theorems in number theory.

Articulation Matrix

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

UNIT I **9 Hours**

FIELDS

Group Theory - Rings and Polynomials - Fields.

UNIT II **9 Hours**

FINITE FIELDS AND POLYNOMIALS

Finite Fields - Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite Fields.

UNIT III **9 Hours**

DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS

Division algorithm- Base-b representations - number patterns - Prime and composite numbers - Fibonacci and Lucas numbers - Fermat numbers - GCD - Euclidean Algorithm - Fundamental theorem of Arithmetic - LCM.

UNIT IV **8 Hours**

DIOPHANTINE EQUATIONS AND CONGRUENCES

Linear Diophantine equations - Congruence s - Linear Congruence s - Applications: Divisibility tests - Modular Designs - Chinese remainder theorem - 2x2 linear systems.

UNIT V **10 Hours**

CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS

Wilson s theorem - Fermat s Little theorem - Euler s theorem - Euler s Phi functions - Tau and Sigma functions - Perfect numbers - Mersenne Primes - Mobius Function.

Total: 45 Hours

Reference(s)

1. Lidl.R., and Pilz. G., Applied Abstract Algebra, Springer-Verlag, New Delhi, 2nd Edition, 2006.
2. Thomas Koshy, Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.
3. San Ling and Chaoping Xing, Coding Theory: A first Course, Cambridge Publications, Cambridge, 2004.
4. Niven.I, Zuckerman.H.S., and Montgomery, H.L., An Introduction to Theory of Numbers, John Wiley and Sons, Singapore, 2004.

18GE0M3 MATHEMATICAL FINANCE AND QUEUEING THEORY

3 0 0 3

Course Objectives

- To provide the required fundamental concepts in probability and queueing models and apply these techniques in networks, image processing etc.
- Acquire skills in analyzing queueing models.

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. Identify the properties of stochastic process in finance
2. Interpret the concept and applications of Statistics in finance.
3. Demonstrate the basics of finance using the notions of statistics.
4. Assess the classifications and the properties of queues.
5. Implement the concepts of queue in open and closed networks.

Articulation Matrix

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

UNIT I **9 Hours**

APPLIED STOCHASTIC CALCULUS

Brownian motion - Constructions - Non differentiability - Quadratic variation - Stochastic integration - Construction of Ito integral and properties ,the Ito formula - Feynman-Kac formula

UNIT II **9 Hours**

STATISTICS

Basic parameter estimation - Maximum likelihood estimation - Distributions - Regression techniques - Tests for normality - QQ plots - Hypothesis testing - Numerical examples in R.

UNIT III **9 Hours**

CONTINUOUS-TIME FINANCE

Black-Scholes-Merton model of stock prices as geometric Brownian motion, derivation of the Black-Scholes-Merton partial differential equation, the Black-Scholes formula and simple extensions of the model, self-financing strategies and model completeness, risk neutral measures, the fundamental theorems of asset pricing, continuous time optimal stopping and pricing of American options, forwards and futures in Black-Scholes-Merton model.

UNIT IV **9 Hours**

QUEUEING THEORY

Markovian queues - Birth and Death processes - Single and multiple server queueing models - Little s formula - Queues with finite waiting rooms - Finite source models.

UNIT V **9 Hours**

NON-MARKOVIAN QUEUES AND QUEUEING NETWORKS

M/G/1 queue - Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases - Series queues - Open and closed Jackson networks.

Total: 45 Hours

Reference(s)

1. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.

2. S. Shreve, Stochastic Calculus for Finance, Vol. 1 and Vol. 2, Springer, 2004.
3. G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.
4. Taha, H.A., Operations Research, Pearson Education, Asia, 8th Edition, 2007.

18GE0E1 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 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. 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, Fractional, 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

18GE0E2 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 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. 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

18EI001 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

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

n. 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.

Course Outcomes (COs)

1. Identify the necessity of instrumentation in aircraft
2. Interpret an aircraft system using desired components
3. Explain the working principle and classification of aircraft engines
4. Attribute an aircraft cable control system components
5. Design controllers to control an aircraft in nonlinear position

Articulation Matrix

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

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 **7 Hours**

AIRCRAFT SYSTEMS AND COMPONENTS

Hydraulic Control System - Pneumatic systems- working principles - typical pneumatic power system -Air Conditioning System - Cabin Pressurization System (Cockpit and Passenger Compartment) - Fuel System - Lubrication systems

UNIT III **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 IV **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 V **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

FOR FURTHER READING

Autopilot System, Vibration, Temperature, Pressure Measuring Instruments, Stabilization control instruments

Total: 45 Hours

Text Book(s)

1. Nagabhushan.S.Sudha.L.K,"Aircraft instrumentation and Systems", International publishing house Private limited, 2014

Reference(s)

1. Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993.
2. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995
3. Treager, S., "Gas Turbine Technology", McGraw Hill 1997

18EI002 FIBER OPTICS AND LASER BASEDINSTRUMENTATION

3 0 0 3

Course Objectives

- To enhance the student knowledge in fiber optics fundamentals and fabrication
- To be recognized with industrial applications of fibers
- To understand the fundamental concepts about lasers
- To identify and describe various fiber optic imaging and optoelectronic sensor 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
l. Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering practice.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
n. 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.

Course Outcomes (COs)

1. Summarize the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Explain the fundamentals of laser, types of laser and its working
4. Outline the applications of laser for industrial applications
5. Differentiate the use of laser instruments for various medical applications

Articulation Matrix

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

UNIT I **9 Hours**

OPTICAL FIBERS AND THEIR PROPERTIES

Principles of light propagation through a fiber - different types of fibers and their properties - relative merits and demerits - fiber optics production and components - technology of preformed fabrication - fiber drawing - mechanical and thermal characteristics - light sources - photo detectors -source coupling, splicing and connectors.

UNIT II **9 Hours**

INDUSTRIAL APPLICATION OF OPTICAL FIBERS

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

UNIT III **9 Hours**

LASER FUNDAMENTALS

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

UNIT IV **9 Hours**

INDUSTRIAL APPLICATION OF LASERS

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing

UNIT V **9 Hours**

HOLOGRAM AND MEDICAL APPLICATIONS

Holography: basic principle, methods - holographic interferometry and application, holography for non-destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology

FURTHER STUDY

Fabrications of multi-component glass fibers - loss and bandwidth limiting mechanism - fiber optic imaging.

Total: 45 Hours

Reference(s)

1. J.M. Senior, Optical Fiber Communication - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. G. Keiser, Optical Fiber Communications, McGraw Hill, 2010.
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

18EI003 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 one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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	1	2	1								2		2	2
2	2	2	3								1		2	3
3	2	2	2								2		2	3
4	1	2	3								2		2	3
5	2	2	3								2		2	3

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

Transducers and data acquisition - The Constituent Elements of an Instrumentation System - Fault Tolerance, Protection Layer, and System Security.

Total: 45 Hours

Reference(s)

1. C. D. Johnson, 'Process Control Instrumentation Technology', 8th Edition, Prentice Hall, 2006.
2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.
3. R.W. Miller, 'Flow Measurement Engineering Handbook', Mc-Graw Hill, New York 1996.
4. Bela G. Liptak, 'Instrument Engineers Handbook - Process Control and Optimization', 4th Edition, Vol.2, CRC Press.

18EI004 STANDARDS AND CALIBRATION 3 0 0 3

Course Objectives

- To Understand about the definitions and standards in calibration techniques.
- To provide exposure on various calibration techniques for Electro technical, Thermal and Pressure parameters
- To learn the standard operating procedure and certificate formation.
- To Select the specified equipment and resources from the detailed scope.
- To understand, analyze and evaluate various uncertainties that meet the desired specifications and requirements

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.
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.
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.

Course Outcomes (COs)

1. Understand the definitions and standards in calibration techniques.
2. Select the specified equipment and resources from the detailed scope.
3. Analyze the standard operating procedure of various calibration techniques for Electro technical, Thermal and Pressure parameters
4. Create the calibration certificate as per specified standards.
5. Evaluate various uncertainties that meet the desired requirements.

Articulation Matrix

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

UNIT I **9 Hours**

CALIBRATION STANDARDS

Definitions of related terms and phrases - Standards - NABL-121, NABL 141, NABL 160, NABL 161 & NABL 165b- ISO GUM - Overview of ISO/IEC 17025.

UNIT II **9 Hours**

MEASUREMENT AND CALIBRATION SYSTEMS

Introduction - Calibration methods - Static calibration - Classification of errors - Limiting error and probable error - Error analysis - Statistical methods - Odds and uncertainty.

UNIT III **9 Hours**

PLANNING AND SELECTION OF EQUIPMENT /REFERENCE MATERIALS

Scope - General requirements: Impartiality, Confidentiality - Structural requirements - Resource requirements: Personnel, Facilities and environmental conditions - Equipment - Metrological traceability - Externally provided products and services.

UNIT IV **9 Hours**

CALIBRATION PROCEDURES AND CALIBRATION CERTIFICATES

Selection, verification and validation of methods - Sampling - Handling of test or calibration items - Technical records - Ensuring the validity of results - Reporting of results.

UNIT V **9 Hours**

UNCERTAINTY OF MEASUREMENT

Measurement uncertainty: Estimation and reporting - Random and Systematic uncertainty - Estimation of systematic uncertainty - Combined uncertainty - Expanded uncertainty - Selection of the confidence level - Evaluation of Type-A & Type-B uncertainties.

FURTHER READING

Optical Instruments - Pressure and Torque Instruments - Gauges - Probes - Electrical Measuring Instruments - Radiation-Sensitive Instruments

Total: 45 Hours

Reference(s)

1. Measurement of Electro technical parameters using FLUKE - 5520A calibrator.
2. Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.

3. L. Kirkup, An Introduction to Uncertainty in Measurement, Cambridge University Press, 2010.

18EI005 DATA COMMUNICATION ANDNETWORKS

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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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. 5: 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

HART and smart instrumentation HART protocol,Physical layer, Data link layer and its benefits - Troubleshooting of HART

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

18EI006 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.
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. 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	1	2		3										
2	1	2	3	3										
3	1	2	3											
4	1	2		3										
5	1	2	3											

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, Thyristor control of heating element

UNIT V **8 Hours**

DRIVES

Determination of speed and torque requirements for specific motion profiles, Introduction to DC drives - AC drives-Frequency control - Stepper motor drives- Position control- Servo drives-

applications.

FOR FURTHER READING

AC voltage controller, Static Kramer Drive and Scherbius Drive

Total: 45 Hours

Reference(s)

1. Dr.P.S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi, 2012.
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics: Converters Applications and Design, Wiley India, New Delhi, 3rd edition, 2010.
3. Singh. M.D & Khanchandani, K.B Power Electronics Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010
4. Muhammad H. Rashid, Power Electronics Circuits, Devices & Applications, Prentice Hall of India, New Delhi, 2013

18EI007 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

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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Understand the fundamentals of hydraulic and pneumatic systems.
2. Identify various hydraulic system components and to illustrate the construction and working of various pumps and actuators.
3. Outline the selection and design of hydraulic system.
4. Identify various pneumatic system components and to illustrate the construction and working of various pumps and actuators.
5. Design of pneumatic circuit 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	1	3	2										3
4	1	1	3	2										3

5	1	1	3	2										3

UNIT I **5 Hours**

FUNDAMENTALS OF HYDRAULICS AND PNEUMATICS

Introduction to fluid power, properties - hydraulic fluids, air. Selection of hydraulic fluids, comparison between hydraulics and pneumatics.

UNIT II **10 Hours**

ELEMENTS OF HYDRAULIC SYSTEMS

Pumps - types, characteristics. Valves for control of direction, flow and pressure - types, typical construction details, Actuators -types and constructional details

UNIT III **10 Hours**

HYDRAULIC SYSTEM DESIGN

Power pack elements, design. Pipes- material, pipe fittings. seals and packing. Maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes. Heat generation in hydraulic system

UNIT IV **10 Hours**

ELEMENTS OF PNEUMATIC SYSTEMS

Components, constructional details, filter, lubricator, regulator, constructional features, types of actuators, control valves for direction, pressure and flow, air motors, air hydraulic equipments

UNIT V **10 Hours**

PNEUMATIC CONTROL SYSTEM DESIGN

General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.

FOR FURTHER READING

Hydraulic power steering, Hydro-Mechanical servo systems, Air brakes on buses and trucks, Roller coaster

Total: 45 Hours

Reference(s)

1. Anthony Esposito,Fluid Power with Application, Pearson Education (Singapore) Pvt. Ltd, Delhi, India, 2003.
2. Srinivasan R, Hydraulic and Pneumatic Controls, McGraw Hill education (India) Pvt. Ltd, 2010.
3. MajumdarSR,Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw- Hill., New Delhi, 2003.
4. Majumda SR,Pneumatic Systems: Principles and Maintenance, Tata McGraw- Hill., New Delhi, 1996.
5. Peter Rohner, Fluid Power Logic Circuit Design Analysis, Design, Method and Worked Examples, The Macmillan Press Ltd., UK 1979
6. Werner Deppert and Kurt Stoll, Pneumatic Controls: An Introduction to Principles, Vogel-Druck Wurzburg, Germany, 1975.

18EI008 MICRO ELECTRO MECHANICALSYSTEM

3 0 0 3

Course Objectives

- To understand the concept of micromachining techniques.
- To get adequate knowledge about various etching techniques in micromachining.

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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Explain the characteristics, electrical and mechanical concepts and materials used for MEMS design
2. Examine the working principle and Techniques involved in Micro Sensors based on electrostatic, thermal properties
3. Organize the type of sensors and actuators in MEMS and selecting suitable sensors for the various applications
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											
2	2	3	1	1										
3	1	2	3	2	1									
4	2	1	2	3	1									
5	2	1	2	3	3								2	

UNIT I **9 Hours**

INTRODUCTION

MEMS Technology - Definition - Laws of Scaling - Intrinsic Characteristics of MEMS - Multi disciplinary nature of MEMS - Energy Domains - Sensors, Transducers and Actuators - Silicon based MEMS processes - Stress and strain analysis - Applications of MEMS in various industries.

UNIT II **11 Hours**

MICRO SENSORS

Working principle of Microsystems - Micro actuation techniques - Properties and Types of Micro sensors - Capacitor Types - Thermal Sensing and expansion - Magnetic Actuators - Micromagnetic components - Micro accelerometers

UNIT III **10 Hours**

SENSORS AND ACTUATORS

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, Acoustic, Tactile and Flow sensors Applications

UNIT IV **8 Hours**

FABRICATION AND MICRO MACHINING

Introduction - Photolithography - Ion implantation - Diffusion - Oxidation- CVD - Physical vapor deposition - Etching Techniques: Dry - Wet Etching; Gas Phase Etchants - Surface Micro Machining LIGA - Micro system packaging materials - Packing Techniques - Bonding and Sealing

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

Soft sensors, Integrated micro array

Total: 45 Hours

Text Book(s)

1. Foundation of MEMS by Chang Liu. Pearson Education
2. Nadim Maluf, An introduction to Micro electro mechanical system design, Artech House, 2011

Reference(s)

1. MEMS and Microsystems Design and Manufacture by Tai-Ran Hsu. Tata McGraw-Hill Publishing Company Ltd.
2. Mohamed Gad-el-Hak, The MEMS Handbook, CRC press Baco Raton, 2012
3. Julian w. Gardner, Vijay k. varadan and Osama O.Awadelkarim, Micro sensors MEMS and smart devices, John Wiley & son LTD, 2010

18EI009 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.

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. Design, develop and realize advanced control schemes in different platforms such as

microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Explain the components and concepts related to the digital control system
2. Determine the response of a discrete time system and Investigate the stability of the discrete time system
3. Design a digital compensator / controller using frequency and time domain technique.
4. Formulate the state space model and compute the solutions of discrete time state space equation.
5. Design the state feedback controller / observer for a discrete time control system.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO DIGITAL CONTROL

Introduction - components and configuration of digital control system - discrete time system representation - sampling theorem - Mathematical modelling of sampling process - zero order hold - first order hold - Data reconstruction.

UNIT II **10 Hours**

MODELING AND STABILITY ANALYSIS DISCRETE-TIME SYSTEMS

Revisiting Z transform - Modified Z transform - Mapping of splane to z plane - Pulse transfer function - Pulse transfer function of closed loop system - Jury stability test - Transient and steady state responses

UNIT III **11 Hours**

DESIGN OF SAMPLED DATA CONTROL SYSTEMS

Root locus method - Bode plot - Lead, lag and lag-lead compensator design using time, frequency domain - Discrete PID Controller - Design of digital control systems with deadbeat response.

UNIT IV **8 Hours**

DISCRETE STATE SPACE MODEL

Introduction to state variable model - Various canonical forms - Characteristic equation, state transition matrix - Solution to discrete state equation - Controllability and observability.

UNIT V **8 Hours**

STATE FEEDBACK DESIGN

Pole placement by state feedback - Set point tracking -controller - Full order observer - Reduced order observer

FOR FURTHER READING

Output feedback design - Linear Quadratic Regulator (LQR) design - Simulation of types of digital controller - Simulation of discrete system to analyse the stability - Simulation of discrete time state equation - Simulation of compensation techniques.

Total: 45 Hours

Text Book(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. B.C.Kuo, Digital Control System, 2nd Edition, Oxford University Press, 2010.
4. I.J. Nagarath and M. Gopal, Control System Engineering, New age International Pvt. Ltd, New Delhi 2011.

Reference(s)

1. Lawrence J. Kamm, Understanding Electro Mechanical Engineering: An Introduction to Mechatronics, Prentice Hall of India Pvt., Ltd., 2000.
2. Nitaigour Premchand Mahadik, Mechatronics, Tata McGraw-Hill publishing Company Ltd, 2009.

18EI010 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 MIMO plant based on modeling and proposed control action
- To interpret about multi-loop, multivariable, batch control and plant wide control schemes
- To analyze the steps involves in optimization and monitoring 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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Interpret the various advanced single loop control schemes
2. Investigate the need for multi-loop and multivariable control systems
3. Formulate the factors involved in batch control and plant wide control
4. Implement Model based control schemes for given systems
5. Produce optimum solutions and monitoring strategies for real time process plant

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										1	2
3	1	2	3										1	2
4	1	2	3										1	2

5	1	2	3										1	2

UNIT I **8 Hours**

ENHANCED SINGLE-LOOP CONTROL STRATEGIES

Cascade control-Time delay compensation-Inferential control-Selective control/Override systems-Adaptive and Smith predictor control

UNIT II **10 Hours**

MULTI-LOOP AND MULTIVARIABLE CONTROL SYSTEMS

Process interaction and control loop interaction, pairing of controlled and manipulated variables - Singular value Analysis - Tuning of multi-loop PID control systems - Decoupling and multivariable control strategies - strategy for reducing control loop interaction

UNIT III **9 Hours**

BATCH CONTROL AND PLANT WIDE CONTROL

Batch Process Control: Sequential and Logic Control-Control during the batch - Run-to-Run Control - Batch Production management- Plant Wide Control: Control issues-Interaction on plant and control system design- effect of Control structure on closed loop performance- Case Study: MPN and HDA process

UNIT IV **10 Hours**

MODEL BASED CONTROLLER DESIGN

Internal Model Control (IMC): Structure - IMC design procedure - Model Predictive Control (MPC): Predictions for SISO and MIMO models-Control calculations-Selection of design and tuning parameters- Implementation of IMC and MPC for distillation column control.

UNIT V **8 Hours**

REAL TIME OPTIMIZATION AND PROCESS MONITORING

Optimization: Basic requirements-Problem formulation and solution-Unconstrained and constrained optimization-Linear Programming-Quadratic and Nonlinear Programming-Genetic algorithm based Model and Controller parameter optimization-Monitoring: Quality control charts-Multivariate statistical Techniques-Control performance monitoring

FOR FURTHER READING

Optimization issues in solving quadratic problems

Reference(s)

Total: 45 Hours

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

18EI011 CHEMICAL PROCESS SYSTEMS **3 0 0 3**

Course Objectives

- To introduce various chemical process fundamentals.
- To model different process in chemical industries
- To analyse some benchmark 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 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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Interpret the fundamentals of chemical process engineering
2. Implement the material balances in simple chemical process for model determination
3. Interpret the fundamentals of fluid mechanics
4. Analyse different components of P&I diagram.
5. Outline the applications of chemical processes such as distillation columns and reactors with their P&I diagram.

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	1	2							2	1	2	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 Pumps - Agitation and Mixing - Compressors

UNIT IV **9 Hours**

UNIT IV PROCESS AND INSTRUMENTATION DIAGRAM

Symbol identification of mechanical equipment - Process connections - Instruments symbols - Control loop.

UNIT V **9 Hours**

APPLICATIONS

Fundamental principles and classification of Distillations, Heat exchangers-Steam Drum Level-Membrane Process - Energy and Mass Conservation in process systems and industries

FOR FURTHER READING

Introduction to chemical reactors, pH neutralization.

Reference(s)

Total: 45 Hours

1. G.T. Austin, R.N. Shreve, Chemical Process Industries, 5th ed., McGraw Hill, 1984 5.
2. W.L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, Sixth Edition, McGraw Hill, 2011.
3. R. M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd ed., John Wiley, New York, 2012
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

18EI012 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and

environmental considerations.

d. Conduct investigations of complex problems using research-based knowledge and research methods, including the 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 Neuro-fuzzy logic based controllers and explores 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	1	1	1										
2	2	1	2		1									
3	2	1	3		2									
4	1	2	3											
5	1	2			2									

UNIT I **9 Hours**

ARTIFICIAL NEURAL NETWORK

Introduction - biological neuron and their artificial models - neuron modelling - 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 **9 Hours**

FUZZY LOGIC SYSTEMS AND CONTROL

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 logic controller: Mamdani and Sugeno-Takagi architecture.

UNIT IV **9 Hours**

NEURO-FUZZY MODELING

Adaptive Neuro - Fuzzy Inference Systems-Coactive Neuro-Fuzzy Modelling - Classification and Regression Trees - Data Clustering Algorithms- Rule base Structure Identification - Neuro-Fuzzy Control.

UNIT V **9 Hours**

APPLICATIONS

Fuzzy controller for inverted pendulum, image processing, blood pressure during anaesthesia - introduction to neuro-fuzzy controllers

FOR FURTHER READING

Introduction to Machine learning, Deep Learning

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.

18EI013 REAL TIME EMBEDDED SYSTEM 3 0 0 3

Course Objectives

- To provide in depth knowledge about embedded processor, its hardware and software
- To understand the embedded system design and their operating system
- To apply knowledge of embedded processor architecture in 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.
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.
m. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. To illustrate the architecture and the functionality of ARM Microprocessor
2. To Summaries the architecture and the functionality of computing devices
3. To outline the basic concepts of operating system
4. To Implement a interfacing of networks with Microprocessor/ Microcontroller
5. To design a real time application for various domain using embedded system

Articulation Matrix

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

2	2	2	2											
3	2	1	2							-				
4	2	1											2	2
5	2	2											2	1

UNIT I **9 Hours**

INTRODUCTION TO ARM PROCEESORS

Fundamentals of ARM, ARM Instruction set, Thumb Instruction set, ARM assembly language programming, Digital Signal Processing in ARM, Exceptions & Interrupt Handling.

UNIT II **9 Hours**

COMPUTING PLATFORM AND DESIGN ANALYSIS

CPU buses - Memory devices - I/O devices - Memory Protection Units - Memory Management Units - Component interfacing - Design with microprocessors - Development and Debugging - Program design - Model of programs - Assembly and Linking - Basic compilation techniques - Analysis and optimization of execution time, power, energy, program size - Program validation and testing.

UNIT III **9 Hours**

PROCESS AND OPERATING SYSTEMS

Multiple tasks and multi processes - Processes - Context Switching - Scheduling policies - Multiprocessor - Inter Process Communication mechanisms - Evaluating operating system performance - Power optimization strategies for processes - Firmware and Operating Systems for ARM processor.

UNIT IV **9 Hours**

HARDWARE ACCELERATES

Accelerators - Accelerated system design-Distributed Embedded Architecture - Networks for Embedded Systems - Network based design - Internet enabled systems.

UNIT V **9 Hours**

CASE STUDY

Hardware and software co-design - Data Compressor - Software Modem - Personal Digital Assistants - Set-Top-Box, System-on-Silicon - FOSS Tools for embedded system development.

FOR FURTHER READING

Automotive networking, Basics of ABS

Total: 45 Hours

Reference(s)

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developer""s guide Designing and Optimizing System Software, Morgan Kaufmann publishers, 2004.
1. David E-Simon, An Embedded Software Primer, Pearson Education, 2007.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming, Dreamtech Press, 2005.
3. Tim Wilmshurst, An Introduction to the Design of Small Scale Embedded Systems, Pal grave Publisher, 2004.
4. Wayne Wolf, Computers as Components - Principles of Embedded Computer System Design, Morgan Kaufmann Publisher, 2006.

18EI014 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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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. Mobile robots dynamics (Newtonian dynamics).

UNIT III **8 Hours**

ROBOT POWER SOURCES AND END EFFECTOR

Power Sources: Hydraulic, pneumatic and electric drives - mechanical transmission-gear transmission, belt drives, cables, roller chains, rotary to linear motion conversion, rotary to rotary motion conversion. 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 - Multiple robots - Machine interface 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.

18EI015 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 fire alarm system and various access control systems
- To get knowledge in security systems of 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering

practice.
h. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
l. Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering practice.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
n. 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.

Course Outcomes (COs)

1. Develop HVAC system architecture for building automation with human comfort
2. Demonstrate and analyze 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	3	2	1			1	1	1				1	1	2
2	3	2	1			1	1	1				1	1	2
3	3	2	1			1	1	1				1	1	2
4	3	2	1			1		1				1	1	2
5	3	2	1			1		1				1	1	2

UNIT I **9 Hours**

INTRODUCTION TO BUILDING AUTOMATION SYSTEM

Fundamentals: Introduction to HVAC - Basic Processes (Heating, Cooling) - Air Properties - Psychometric Chart - Heat Transfer mechanisms - Human Comfort: Human comfort zones - Effect of Heat, Humidity - Heat loss

UNIT II **9 Hours**

PROCESSES

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, Principles of operation, FAS Components: Field Components, Panel Components and Applications. Power Supply design for FAS. Cause & effect matrix: Examples. Fire Standards: NFPA 72A, BS 5839, Indian Standards

UNIT IV **9 Hours**

SECURITY SYSTEMS

Introduction to Security Systems, Concepts of 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 SYSTEM

Concept, Components, Technology and Advanced Applications Security Design: Security system design for verticals

FOR FURTHER READING

Safety Interlocks

Total: 45 Hours

Reference(s)

1. Reinhold A. Carlson, Robert A. Di Giandomenico, Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs), R.S. Means Company, Inc 2012
2. William B. Riddens, Understanding Automotive Electronics, Sixth Edition, Butterworth Heinemann Woburn, 2010.
3. Michael F. Hordeski, HVAC Control in the New Millennium, First edition, Fairmont Press, 2011.
4. NJATC Building Automation Control Devices and applications, First edition, Amer Technical Pub, 2012.

18EI016 INSTRUMENTATION INPETROCHEMICAL INDUSTRIES

3 0 0 3

Course Objectives

- To understand the process involved in petroleum refineries
- To impact 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.
f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
h. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
l. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
n. 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.

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	2	-	-	-	-	-	-	-	-	-	-	1	-	-
2	3	-	-	-	-	1	1	1	-	-	-	1	2	2
3	3	-	-	-	-	1	1	1	-	-	-	1	2	2
4	3	-	-	-	-	1	1	1	-	-	-	1	2	2
5	2	-	-	-	-	2	2	2	-	-	-	1	-	-

UNIT I **7 Hours**

INTRODUCTION

Formation of oil and gas - 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 - Catalytic conversion - control of distillation column -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 - Feedback control- Integrated approach - 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

Text Book(s)

1. Ram Prasad, Petroleum Refining Technology, Khanna Publishers Ltd, New Delhi, 2007

Reference(s)

1. B.G. Liptak, Instrumentation in Process Industries, Chilton Book Company, New York,1973
2. B.G. Liptak, Instrument Engineers Handbook Volume II, 2003

18EI017 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.
c. Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
f. Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
g. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
h. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
l. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
m. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

Course Outcomes (COs)

1. To recall different types of power generation methods and to explain the basic 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 implement control schemes used for the control of combustion of air, fuel, draught, pulveriser, flue gas dew point and soot blowing
4. To analyze major control schemes for boiler control parameters like feed water, drum level, steam, temperature and boiler interlocks
5. To organize the control methods used in nuclear power plant and safety methods in turbine control

Articulation Matrix

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

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- pollution monitoring Instruments - dust monitor

UNIT III **9 Hours**

BOILER CONTROL LOOPS I

Coal handling: Pulverizers and Pulverizers control - Furnace Draught control - Combustion control: Fuel/Air ratio, combustion efficiency - oxygen, CO and CO2 trimming, excess air Ã¢?? flue gas dew point control - Burners for liquid and solid fuels - burner management - soot blowing operation

UNIT IV **9 Hours**

BOILER CONTROL LOOPS II

Boiler feed water processing and control - Types of boilers like FBC, CFBC, Fluidized Bed - drum level control - steam temperature and pressure control - Super heater control - deaerator control - furnace safety interlocks and boiler interlocks -. boiler efficiency calculation

UNIT V **9 Hours**

NUCLEAR POWER PLANT INSTRUMENTATION AND TURBINE CONTROL

Nuclear power plant instrumentation: Piping and instrumentation diagram of different types of nuclear power plant, Nuclear reactor control loops, reactor dynamics - safety instrumentation, reliability aspects. Turbine-control: Types of steam turbines - governing system - Speed and load control - Vibration and shell temperature control - lubricant oil temperature control - cooling system

FOR FURTHER READING

Application:Tidal power plant - Geo-thermal power generation - Solar Power Satellite - Recent trends in thermal power plant.

Total: 45 Hours

Text Book(s)

1. Swapan Basu and Ajay Kumar, Power Plant Instrumentation and Control,Elsevier,2015

Reference(s)

1. Krishnaswamy.K and Ponnibala.M., Power Plant Instrumentation, PHI Learning Pvt.Ltd., New Delhi, 2011
2. Jain R.K., Mechanical and Industrial Measurements,Khanna Publishers, New Delhi, 2013
3. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2013
4. Jain R.K., Mechanical and Industrial Measurements,Khanna Publishers, New Delhi, 2013
5. David Lindsley, Power Plant control and Instrumentation, Institution of Electrical Engineers, London, 2000

18EI018 INSTRUMENTATION IN AGRICULTUREAND FOOD PROCESSING INDUSTRIES

3 0 0 3

Course Objectives

- To get adequate knowledge about various sensors used in agriculture and food processes
- To know about various measurements in agriculture field and its automation
- To have a knowledge about automation in food processing 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Interpret the necessity of instrumentation and sensor requirements in agriculture and food processing
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 irrigation
5. Implement the appropriate electronic control circuits required for farm machinery used in agriculture

Articulation Matrix

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

UNIT I **7 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 **10 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 **10 Hours**

INSTRUMENTATION IN FOOD INDUSTRY

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 **9 Hours**

IRRIGATION INSTRUMENTATION

Agriculture process parameters and control - Water distribution and management control - Auto-Drip irrigation systems

UNIT V **9 Hours**

FARM MACHINERY AUTOMATION

Automation in Earth Moving Equipment and farm implements - pneumatic, hydraulic and electronic control circuits

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. Principles of Agricultural Engineering Volume I and Volume II by A.M. Michael and T.P.Pjha, Jain Brothers 2017
2. Soil, Plant, Water and Fertiliser Analysis by P.K.Gupta, Agrobios, 2000
3. Seed Technology by Rattan Lal Agrawal 2nd Edition, 2017
4. Perry G CIGR Handbook of Agricultural Engineering: Information technology, American Society of Agricultural Engineers, 2006 Digitized 12 Apr 2011
5. Johnson C. D.Process Control Instrumentation Technology 7th Edition, Pearson Education, New Delhi, 2013
6. Jonathan Love Process Automation Handbook: A Guide to Theory and Practice, springer, 2007

18EI019 INSTRUMENTATION AND CONTROL FORPROCESS INDUSTRIES

3 0 0 3

Course Objectives

- To get adequate knowledge about the standards in process industries
- To know about various measurements involved in process control
- To have a knowledge about instrumentation in 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.
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. Understand the basic ISA standards with the control processes involved.
2. Select instrumentation techniques for Iron and Steel Industries
3. Implement instrumentation techniques for Paper Industries

4. Execute instrumentation techniques for Sugar Industries
5. Demonstrate instrumentation techniques for Cement Industries

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											
4	1	2		3										
5	1	2	3											

UNIT I **6 Hours**

ISA STANDARDS AND BASIC PROCESS CONTROL

ISA Standard Purpose - loop identification- Instrument line and function symbols. Temperature, Pressure and Flow control.

UNIT II **12 Hours**

INSTRUMENTATION IN IRON AND STEEL INDUSTRIES

Description of the process - typical control system in iron and steel industry - blast furnace and basic oxygen furnace - blast furnace stove combustion control system - gas and water control in BOF furnace - stand casting mold level control.

UNIT III **10 Hours**

INSTRUMENTATION IN PAPER INDUSTRIES

Description of process of pulp and paper industry - blow down task control - stock chest level control - basis weight control of a paper machine - valves used in paper industry - consistency control.

UNIT IV **7 Hours**

INSTRUMENTATION IN SUGAR INDUSTRIES

Flow diagram of a sugar plant and its instrumentation set up - batch process - Fermenter Control - juice extraction control process and instrumentation.

UNIT V **10 Hours**

INSTRUMENTATION IN CEMENT INDUSTRIES

Level Measurement in rock crushers, Solid level measurement in rock crushers, Build-up measurement in cyclones, Mass flow measurement in conveyor belts, Pressure measurement in cement silos.

FOR FURTHER READING

Instrumentation systems in cold and hot rolling mills.

Total: 45 Hours

Reference(s)

1. B.G.Liptak, Instrumentation in Processing Industries, Chiller Book Co, 2015
2. ISA, Instrumentation Symbols and Identifications, ISA Society (1st Module), 2017
3. Andrews & William, Applied Instrumentation in Process Industries, 2016
4. Considine and Ross, Handbook of Applied Instrumentation, 2018
5. Dale R. Patrick & Stephan W. Fardo, Industrial Process Control Systems, Vikas Publishing House, 2015

18EI020 SMART AND WIRELESSINSTRUMENTATION

3 0 0 3

Course Objectives

- To acquire knowledge on smart instrumentation system with their communication protocol
- To know about wireless sensor networks used in various process industries
- To get adequate knowledge on design, development and challenges in smart and wireless 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications

Course Outcomes (COs)

1. Interpret the functioning elements of a smart sensor and its standards for sensor interfacing
2. Infer the concepts of smart instrumentation with its HART communication protocol
3. Design the structure of wireless instruments along with its power management system
4. Attribute industrial wireless technology for process monitoring applications
5. Determine the challenges and opportunities of recent techniques in smart and wireless systems

Articulation Matrix

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

UNIT I **9 Hours**

SMART SENSORS

Functional elements of smart sensors: Primary and Secondary sensors - Amplifiers - Filters - Converters - Compensators - Information coding / processing - Data communication - Standards for smart sensor interface Applications

UNIT II **9 Hours**

SMART INSTRUMENTATION

Smart instrumentation system - HART communication protocol - Diagnosis of smart instruments - Remote Calibration - Applications: Smart flow and pressure transmitters

UNIT III **9 Hours**

WIRELESS INSTRUMENTS

Wireless sensors and transducers - Essential components of a Wireless Instrument - Structure of Wireless Instrument - Wireless Bridges, Routers, Gateways and repeaters - Wireless data logging system - Power considerations of Wireless Instruments

UNIT IV **9 Hours**

WIRELESS SENSOR NETWORK

Architecture of Wireless Sensor Network - Effect of IEEE 1451 standards in Wireless Sensor networks - Network Topologies - Energy Issues in Wireless Sensor Networks - Wireless Integrated Network Sensors

UNIT V **9 Hours**

RECENT TRENDS IN SMART AND WIRELESS TECHNOLOGY

Wireless Human Health Monitoring - Wireless Environmental and Habitat Monitoring Systems - Wireless Consumer Products - WSN based smart precision agriculture system - Challenges and opportunities

FURTHER READING

Internet 0f Things - Industry 4.0 - IIOT

Total: 45 Hours

Reference(s)

1. Smart Sensors, Measurement and Instrumentation, Subhas Chandra Mukhopadhyay, SpringerHeidelberg, New York, Dordrecht London, 2013
2. Uvais Qidwai, Smart Instrumentation: A data flow approach to Interfacing, Chapman & Hall,1st Edition, 2013
3. Kazem Sohraby, Daniel Minoli, Taieb Z Nati, Wireless sensor networks: technology, protocols, and applications, John Wiley & Sons, Inc., Hoboken, New Jersey, 2007
4. Wireless Sensor Networks: Architectures and Protocols, Edgar H. Callaway Jr. and Edgar H.Callaway
5. Halit Eren, Wireless Sensors and Instruments Networks, Design and Applications, Taylor andFrancis group, 2006

18EI021 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. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals for solving 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.

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.

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	3	2		1								2		1
2	3	2		1								2		1
3	3	3	2	1								2		2
4	3	3	3	1								2		2
5	3	3	2	1								2		2

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

18EI022 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 specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

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

g. Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering practice.

h. 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 broadest context of technological change.

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

n. 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.

Course Outcomes (COs)

1. Explain the characteristics and various design levels in internet of things
2. Attribute the network design in IoT deployment
3. Apply the IoT design principles on connected devices, domains and various protocol standards
4. Design the IoT ad-hoc network using protocol
5. Analyse the working challenges of IoT on various domain specific applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

1	3	2	1									2	1	1
2	3	2	2									2	1	1
3	3	2	2			2	2	2				2	1	1
4	3	2	2			2	2	2				2	1	1
5	3	2	2			2	2	2				2	1	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, 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 – TCP/IP and UDP, Static and Dynamic Assignment, IP Address, IPv4 and IPv6, Wireless Communication Standards for IoT – WiFi Connectivity include Servers.

UNIT V **9 Hours**

DOMAIN SPECIFIC IOT AND THEIR CHALLENGES

Domain Specific IOT and their challenges: Illustrated Domains – Home Automation, Smart Cities, Environment, Energy, Retail, Logistics, Health and Life Style, Industrial IoT

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 – A Hands-On Approach,VPT, 2014

18EI023 SYSTEM IDENTIFICATION

3 0 0 3

Course Objectives

- To provide an overview system identification based on the Non-parametric methods and spectral analysis methods
- To estimate the system parameters using parametric model structures
- To study the system identification using generalized relay feedback identification
- To familiarize the student with the Identification of systems operating in closed loop as well as practical aspects.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals for solving 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.
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. Obtain the mathematical model of a real time system using Non-parametric and spectral analysis methods.
2. Estimate the system parameters using parametric model structures available in the system identification tool box.
3. Determine the mathematical model for stable and unstable system using relay feedback identification methods.
4. Identify the system Parameter in the closed loop system using direct, indirect and Subspace Identification methods.
5. Explain the procedure and limitation in practical aspects of identification for an experimental setup.

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

System Identification-motivation and overview - Non-parametric methods: Impulse response, step response and Frequency response methods, correlation and spectral analysis methods.

UNIT II **9 Hours**

PARAMETER ESTIMATION METHODS

Parametric model structures-ARX, ARMAX, OE, BJ models - Linear regression - Least square estimates, statistical properties of LS Estimates. Weighted least squares, maximum likelihood estimation, Prediction error methods, Instrumental variable methods, Recursive Least squares method-Exercises using system identification toolbox.

UNIT III **9 Hours**

RELAY FEEDBACK IDENTIFICATION

A generalized relay feedback identification method – model; structure selection- relay feedback identification of stable processes: FOPDT and SOPDT model. Relay feedback Identification of unstable processes: FOPDT and SOPDT model - Illustrative examples

UNIT IV **9 Hours**

CLOSED- LOOP IDENTIFICATION

Identification of systems operating in closed loop: Identifiability considerations – direct identification – indirect identification - Subspace Identification methods: classical and innovation forms, free and structures parameterizations

UNIT V **9 Hours**

PRACTICAL ASPECTS OF IDENTIFICATION

Practical aspects: experimental design – input design for identification, notion for persistent excitation, drifts and de-trending – outliers and missing data – pre-filtering -robustness – Model validation and Model structure determination-case studies. Introduction to Nonlinear System Identification

Total: 45 Hours

Reference(s)

1. Arun K. Tangirala “Principles of System Identification Theory and Practice” CRC Press2018
2. Karel J. Keesman,” System Identification an Introduction”, Springer, 2011.
3. LennartLjung, “System Identification: Theory for the user”, Second edition, Prentice Hall, 1999.
4. Tao Liu, FurongGao, “Industrial Process Identification and control design, Step-test and relay-experiment-based methods”, Springer- Verilog London Ltd, 2012.

18EI024 DEEP LEARNING 3 0 0 3

Course Objectives

- To impart basic knowledge on Deep Neural Networks.
- To understand various methods and algorithms of Deep Learning.
- To familiarize students with computer vision modules and Natural Language Processing.

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.

Course Outcomes (COs)

1. Interpret the advanced methods of machine learning.
2. Analyze and select suitable algorithms for Deep Learning.
3. Apply their knowledge in Deep Learning for computer vision modules and Natural Language Processing.
4. Apply deep learning technologies in computers

5. Apply deep learning to natural language processing

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO MACHINE LEARNING

Numerical Computation: Overflow and Underflow - Gradient based Optimization - Constrained Optimization - Learning Algorithms: Capacity - Overfitting - Under fitting - Bayesian Classification - Supervised - unsupervised algorithms - Building machine learning algorithm.

UNIT II

INTRODUCTION TO DEEP LEARNING **9 Hours**

Introduction to Tensor Flow: Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras Perceptrons: Perceptron, XOR Gate

UNIT III **9 Hours**

GRADIENT DESCENT AND BACKPROPAGATION

Gradient Descent, Stochastic Gradient Descent, Back propagation, Some problems in ANN Optimization and Regularization: Over fitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyper parameters

UNIT IV **9 Hours**

CONVOLUTIONAL AND RECURRENT NEURAL NETWORK

Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications - Recurrent Neural Networks (RNN)-Long Short Term Memory (LSTM)-RNN language models-Image captioning.**APPLICATIONS OF DEEP LEARNING**

Deep learning applications: Control and Automation, Uncertainty Measurements, Image Processing, Speech Recognition, Video Analytics

Total: 45 Hours

Reference(s)

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. Deep learning, An MIT Press book, 2015.
2. Bengio, Yoshua., Learning deep architectures for AI, Foundations and trends in Machine Learning 2.1, 2009.
3. Duda, R.O., Hart, P.E., and Stork, D.G., Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.
4. Theodoridis, S. and Koutroumbas, K., Pattern Recognition, 4th Edition, Academic Press, 2008.
5. Russell, S. and Norvig, N., Artificial Intelligence: A Modern Approach, Prentice Hall Series in Artificial Intelligence, 2003.

18EI025 DIGITAL IMAGE PROCESSING 3 0 0 3

Course Objectives

- To study about the fundamentals of digital images
- To understand 1D and 2D image transforms
- To gain sound knowledge about various image processing techniques

Programme Outcomes (POs)

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

e. 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. Interpret the image perception and relate it as a mathematical model
2. Analyze the image using various transformation techniques
3. Implement the image enhancement and restoration techniques
4. Determine the appropriate method for image segmentation and recognition
5. Use a suitable image compression technique

Articulation Matrix

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

UNIT I **9 Hours**

DIGITAL IMAGE FUNDAMENTALS

Elements of digital image processing systems - Elements of visual perception - psycho visual model - brightness - contrast - hue - saturation - mach band effect -Image sensing and acquisition- Image sampling and Quantization -Basic relationships between pixels- Two-dimensional mathematical preliminaries.

UNIT II **9 Hours**

IMAGE TRANSFORMS AND ENHANCEMENT

Analysis of 1D DFT - 2D transforms - DFT - Discrete Cosine Transform - Walsh - Hadamard - Slant - Haar- KLT- SVD - Wavelet Transform. Basic Gray Level Transformations - Histogram Processing - Smoothing and Sharpening Spatial Filters- Smoothing and Sharpening Frequency Domain Filters - Homomorphic filtering

UNIT III **9 Hours**

IMAGE RESTORATION

Image degradation/ restoration process model - Noise models - Restoration in the presence of noise only Spatial Filtering- Inverse filtering - Wiener filtering - Geometric transformations.

UNIT IV **9 Hours**

IMAGE SEGMENTATION AND RECOGNITION

Edge detection - edge linking - Basic global and adaptive thresholding - Image segmentation by region growing - region splitting and merging - Image Recognition - Patterns and pattern classes - Matching by minimum distance classifier.

UNIT V **9 Hours**

IMAGE COMPRESSION AND COLOUR IMAGE PROCESSING

Need for data compression - Huffman - Run Length Encoding - Arithmetic coding - Vector Quantization - - Transform Coding - Wavelet coding-Image Compression Standards. Color image processing fundamentals: Pseudo color image processing- Basics of full color image processing.

Total: 45 Hours

Reference(s)

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition, 2010.
2. Milan Sonka, Vaclav Hlavac & Roger Boyle, Image processing, Analysis and Machine Vision, Thomson Asia Prt. Ltd, 4th Edition, 2015.
3. K.William Pratt, Digital Image Processing, John Wiley, 2007.
4. Jayaraman S, Esakkirajan S and Veerakumar T, Digital image Processing, Tata McGraw Hill, 2010.
5. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2002.

18EI026 ENVIRONMENTAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To introduce the role of instrumentation in environmental system.
- To enable the students to familiarize the environmental aspects of water quality, sedimentation and flotation process
- To enable the students to understand the causes of environmental pollutions, like water andair.

Programme Outcomes (POs)

c. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
f. 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. Infer the various techniques used for the measurement and control of environment parameters.
2. Identify the various methodologies in water quality assessment.
3. Differentiate the Sedimentation and flotation methods.
4. Analyze the Waste water and Flow Monitoring Systems
5. Compare Air pollution and sound Pollution systems.

UNIT I **9 Hours**

INTRODUCTION

Necessity of instrumentation & control for environment, sensor requirement for environment, Study of machinery, electric motors types and characteristics, other prime covers, pumps, capacity, operation and maintenance of pumping machinery, air compressors preventive maintenance, break-down maintenance, schedules – Factors to be considered in the selection of the equipments

UNIT II **9 Hours**

WASTE WATER AND AIR POLLUTION MONITORING

Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement, open channel waste water flow measurement. Rain

water harvesting: necessity, methods, rate of NGOs municipal corporation, Govt., limitations. Quality assurance of storage water.

UNIT III **9 Hours**

WATER SUPPLY AND WASTEWATER TREATMENT MACHINERY

Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Drilling equipment, pumping equipment for wells. Machinery required for primary and secondary treatment, sewage pumps, sludge pumps, vacuum filtration equipment, electrically and mechanically operated agitators, mixers, aerators, chlorinators, Surface aerators. Water treatment: Requirement of water treatment facilities, process design.

UNIT IV **9 Hours**

SEDIMENTATION & FLOTATION

General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin , reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution.

UNIT V **9 Hours**

AIR AND WATER POLLUTION CONTROL EQUIPMENTS

Working principles of electrostatic precipitator - cyclone separators - settling chamber - operation and Maintenance. Machinery for solid waste collection and disposal incineration - compactors - magnetic separators incinerators.

Total: 45 Hours

Reference(s)

1. Randy D. Down & Jay H. Lehr, Environmental Instrumentation & Analysis Handbook, Wiley 2005.

2. Peany Howard S, Donal R Rowe and George Tacho Banoylous Teddy, Environmental Engineering, McGraw-Hill, 2007.

3. Nicholas P Cheremisinoff, Handbook of Water and Wastewater Treatment Technologies, Elsevier Science, 2002.

4. M. N. Rao & H. V. N. Rao, Air pollution engineering, Tata McGraw-Hill, India, 1988.

5. Lawrence K. Wang, Yung-Tse Hung, Norman C. Pereira, Air Pollution Control Engineering, Netherlands: Humana Press, 2004.

18EI0YA PROGRAMMABLE LOGICCONTROLLERS

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 PLC 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Explain the fundamental Concepts of Automation
2. Summarize the architecture, interfacing and communication techniques of PLC
3. Execute 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 Push-buttons and toggle switches - Actuators : Solenoid valve - servo motor - electromagnetic relays.

UNIT II **9 Hours**

ARCHITECTURE OF PLC

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, 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 languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming ÃƒÂ¢?? Latching -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 - alarm annunciator system

FOR FURTHER READING

Distributed control System, SCADA and HMI

Total: 45 Hours

Text Book(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015

Reference(s)

1. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India, 2014
2. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes/Elsevier, 2015
3. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014
4. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013

18EI0YB SENSOR TECHNOLOGY 3 0 0 3

Course Objectives

- To impart knowledge about various sensors in multidisciplinary engineering domain
- To familiarize students with different applications and its material handling technology
- To understand the concept of sensing circuits and its static and dynamic characteristics

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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

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. Analyze and select the suitable sensor for different industrial applications
5. Integrate the modern technologies and smart materials to design various sensors

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	1									
3	1	2	3	3	1									2
4	2	1	1	3	3								2	
5	1	2	1	2	3									2

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- Smart Materials

FOR FURTHER READING

Sensor fabrication, Applications of Sensors

Total: 45 Hours

Text Book(s)

1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer

Reference(s)

1. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi 3
2. Mechatronics -Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited)
3. Horowitz, P., and W. Hill. The Art of Electronics. 2nd ed. Cambridge University Press, 1989. ISBN: 9780521370950.

18EI0YC FUNDAMENTALS OF VIRTUALINSTRUMENTATION

3 0 0 3

Course Objectives

- Understand the basic components of Virtual Instrumentation system.
- Learn the developing VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation 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.
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. Identify suitable sensors and design signal conditioning circuits to measure physical parameters for industrial applications
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

Course Outcomes (COs)

1. Understands the concepts of traditional instruments and virtual instruments
2. Summarize the overview of modular programming and the structuring concepts in VI programming
3. Formulate the procedure to install DAQ in various OS and its interfacing methods
4. Apply the VI toolsets for specific applications
5. Develop applications using Virtual Instrumentation software

Articulation Matrix

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

5	3	2	2	1	2				-	1	2	2		1

UNIT I **9 Hours**

INTRODUCTION

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II **9 Hours**

UNIT 2 VI PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III **9 Hours**

UNIT 3 DATA ACQUISITION

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT IV **9 Hours**

UNIT 4 VI TOOLSETS

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory

UNIT V **9 Hours**

UNIT 5 APPLICATIONS

Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

FOR FURTHER READING

Applications of Virtual Instrumentation in linear and non linear systems

Total: 45 Hours

Text Book(s)

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.

Reference(s)

1. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
2. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.

18EI0YD OPTOELECTRONICS AND LASER INSTRUMENTATION

3 0 0 3

Course objective(s)

- To acquire basic concepts of optical fibers and their properties
- To provide adequate knowledge about industrial applications of Lasers
- To provide adequate knowledge about holography and 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.

Course Outcomes (COs)

1. Summarize the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Explain the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

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

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, Nd-Yag, He-Ne, CO_2, 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

Laser Doppler velocity meter - Holography: Principle, Methods, Holographic Interferometers and applications - Electro-optic - Magneto optic - Acousto-optic Modulators

UNIT IV **9 Hours**

MEDICAL APPLICATIONS

Lasers and tissue interaction, Laser instruments for surgery, removal tumours of vocal cords, plastic surgery, Dermatology.

UNIT V **8 Hours**

INDUSTRIAL APPLICATIONS

Material processing applications - Laser heating, melting, scribing, splicing, welding and trimming of materials, removal and vaporization - Laser For Measurement Of Atmospheric Effect

FOR FURTHER READING

Applications of Laser in Medical Field

Total: 45 hours

Reference(s)

1. John M. Senior, Optical Fiber Communications principles and practice, Pearson Educationltd.India, 2010.
2. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
3. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall ofIndia, 2012.
4. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India,2011.
5. Ghatak A.K. and Thyagarajan K, Optical Electronics, Cambridge University press, 1990. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

18EI0XA VIRTUAL INSTRUMENTATION ININDUSTRIAL 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.
n. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

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	1	2			3									1

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

18EI0XB 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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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**

UNIT I

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.

18EI0XC FACTORY AUTOMATION 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.
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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

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	1	2	3		1									1
2	1	2	3				2							3

UNIT I **20 Hours**

UNIT I

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

18EI0XD 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.
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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of 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	2	3		1									1
2	1	2	3				2							3

UNIT I **15 Hours**

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

18EI0XE 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.
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. Design, develop and realize advanced control schemes in different platforms such as microcontroller, PLC, SCADA, DCS and other modern controllers for next level of automation

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	1	2	2				2						2	
2	2	2	2				2						2	

UNIT I **15 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 (P&I) – two phase flow – troubleshooting of fluid flow system – Motor control Standards (included)

Total: 15 Hours

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

18EI0XF VFD BASED INDUSTRIAL APPLICATIONS 1 0 0 1

Course Objectives

- To know working and control schemes of VFD and its applications

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.

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						2	2							

15 Hours

UNIT I

Basic terminology associated with motors and Variable speed drives -variable speed drives - Different types of Drives- Variable Frequency and Variable Voltage drives - Different control modes of VFDs - Discrete and Continuous control schemes - Effect of long distance cables on VFD's Different types of braking - Selection of VFDs based on application

Total: 20 Hours

Reference(s)

1. Insti, E. &. t. H., Variable Speed Pumping: A Guide to Successful Applications, United Kingdom: Elsevier Science, 2004.
2. Anderson, G. D., Variable Frequency Drives: Installation & Troubleshooting!. (n.p.): Create space Independent Pub, 2013.
3. ABB drives, Guide to Variable Speed Drives - Technical Guide No. 4., 2012.
4. Vinod Kumar, Ranjan Kumar Behera, Dheeraj Joshi, Ramesh Bansal :Power Electronics, Drives, and Advanced Applications,CRC Press · 2020
5. Jan A. Melkebeek, Electrical Machines and Drives,Springer International Publishing,2018.

18EI0XG SAFETY INSTRUMENT SYSTEM DESIGN 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)

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. 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						2	2							
2						2	2							

UNIT I **20 Hours**

P&ID – Understanding of P&ID, Design of Interlocks (5 Hours)

a) Introduction to ISA 5.1
b) Understanding and selection of various symbols
c) Instrumentation as per API 554
d) Design and Development of interlocks

Instrumentation Design Specification (Selection Procedure) – (4.5 Hours)

a) Instruments specification for pressure
b) Instruments specification for level
c) Instruments specification for temperature
d) Instruments specification for flow
e) Selection of various Instruments and sizing standards

Instrument Detailing – Index, BOQ, Datasheet and Hook-up drawing preparation (4.5 Hours)

a) Preparation of Instrument Index sheet
b) Instrument Installation BOQ
c) Preparation of Instrument datasheet
d) Preparation of Instrument Hook-up Diagram

Control System Integration Design – Cable schedule, Loop schematics, JB Detailing, PLC Designing, Safety Instrumentation system (4 Hours)

a) Field – Control system communication protocols and integration methods
b) Cable scheduling
c) Preparation of Loop schematics
d) Preparation of JB Details
e) Control system architecture designing
f) Safety Instrumentation system design

Installation, Testing and Commissioning (2 Hours)

a) Instrumentation Installation standards and calibration methods
b) Instrument site testing and loop checking standards
c) System commissioning and stabilization

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

18GE0XA 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

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 prefixes, roots, and suffixes of words from Latin, Greek, Germanic, and Anglo - Saxon
2. Be familiar with the historical aspects of language, including the infusion of Indo - European languages, semantic changes, and the influence of world events through its vocabulary

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Acronyms - Initialisms - Idiomatic Expressions - Euphemisms - Spoonerisms - Malapropisms - Mondegreens - Words derived from Latin, Greek and Germanic/Anglo-Saxon - Affix analogy - Apheresis - Blend word assimilation - Colloquial language

UNIT II **8 Hours**

BASICS OF ETYMOLOGY

Clipped word - Concrete word - Derivatives - Dialect - Diminutive suffix - Dissimilation - Euphemism - Figurative word - Informal language infusion - Jargon - Loan words - Modifiers - Onomatopoeia - Romance language prefix - Semantics - Root-base word - Slang - Word component

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.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To understand the field of psychology,its nature.
- To understand the clinical picture of stress, adjustment disorders, anxiety
- To understand the clinical picture of childhood/adolescent disorders.
- To learn the clinical overview of schizophrenia and suicide.

Programme Outcomes (POs)

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.

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.

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					

UNIT I **7 Hours**

INTRODUCTION TO PSYCHOLOGY

Psychology - Definition - Methods and Scope of Psychology Stress: Stressors - Coping Skills - Adjustment Disorders - Acute Stress Disorders - PTSD Anxiety Disorders: Generalized Anxiety disorder - Panic attack-Phobias - Obsessive Compulsive disorder (OCD).

UNIT II **8 Hours**

PSYCHOLOGICAL DISORDERS

Clinical Picture Childhood and Adolescent Disorders: Mental retardation - Autism-Learning disorders - Eating disorders -Clinical Picture Schizophrenia: Types - Clinical Pictures - Causes - Treatment;Suicide: Risk factors - Suicide prevention.

Total: 15 Hours

Reference(s)

1. Jeffrey E.Hecker,2005):Introduction to Clinical Psychology, New Delhi:Pearson Education.
2. Robert C Carson,James N Butcher & Susan Mineka,(2004): Abnormal Psychology and Modern Life,(11th Edition),New York: Pearson Education.
3. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J.(1993). Introduction to Psychology,7th Ed. New Dehi:Tata McGraw Hill

18GE0XC NEURO BEHAVIORAL 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.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO PHYSIOLOGY

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science.

UNIT II **7 Hours**

PSYCHOLOGICAL BEHAVIOR

Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

Total: 15 Hours

Reference(s)

1. Beck. Robert. Handbook of Physiology. Vol I.
2. Horon C Philip. Sexology and Mind.

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking 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

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.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

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)

UNIT II **8 Hours**

FUNDEMENTALS OF FILMMAKING

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

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE 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

Programme Outcomes (POs)

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.

Course Outcomes (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

Articulation Matrix

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

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga, - History of Yoga- Yoga in todays 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 Hours

Reference(s)

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.
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

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

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

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

18GE0XG 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

Programme Outcomes (POs)

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.

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

Articulation Matrix

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

UNIT I **5 Hours**

FITNESS

Meaning & Definition Need & importance of Physical fitness Types Physical fitness - Exercise, Training and Conditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition Principles of practicing Basic Asana and it important Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

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

Reference(s)

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

18GE0XH 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 procedures of biodegradation of unwanted solid residues

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.

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

Articulation Matrix

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

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

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

18GE0XI BLOG WRITING 1 0 0 1

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

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.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop creative thinking.

Articulation Matrix

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

UNIT I **7 Hours**

CONCEPT

What is blog writing? Types of blog posts personal experience, opinion, reviews, advice, news/updates. Focusing your blog concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

VOICE RELIABILITY

Defining and achieving voice. Exploring various voices. Stylistic tips rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1 0 0 1

Course Objectives

- understand the role of National Service Scheme in community
- identify the needs and problems of the community and involve in problem solving
- develop competence required for group living and acquire leadership qualities

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

Articulation Matrix

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

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure - roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, Day Camps-Basis of adoption of village/slums-Methodology of conducting Survey -Financial pattern of the scheme Coordination with different agencies-Maintenance of the Diary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

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							1		2					

UNIT I **12 Hours**

NCC STRUCTURE AND TRAINING

NCC ORGANIZATION - National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets.

DRILL AND WEAPON TRAINING - Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons. NATIONAL INTEGRATION AND SOCIAL AWARENESS - National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP - Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader.

DISASTER MANAGEMENT AND FIRST AID - Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 20 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM NEW AGE 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

Programme Outcomes (POs)

b. 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 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.

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

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

Articulation Matrix

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

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation –MVP Positioning 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 - Intrapreneurship 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, publishedby the authors, 2010
3. Branson. R. Ãƒ?Ã‚¢??Business stripped bareÃƒ?Ã‚¢??, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP 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 operation alizing creativity based disruption strategy

Programme Outcomes (POs)

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. 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

Articulation Matrix

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

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

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

Reference(s)

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

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

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

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media.

Total: 15 Hours

Reference(s)

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7th Ed.New Dehi:Tata McGraw Hill.

18GE0XP FM RADIO BROADCASTING TECHNOLOGY

1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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 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 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.

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											
3	2	2	2											

UNIT I **3 Hours**

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio- Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-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.

UNIT III **3 Hours**

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. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V **3 Hours**

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- Radio audience -measurements systems.

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, Sean O Siochru, 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.mediacollege.com