B.E. (Electronics and Communication Engineering)

2015 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai

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

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REGULATIONS 2015

(CHOICE BASED CREDIT SYSTEM)

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

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

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

1. ADMISSION

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

1.1 Regular Admission

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

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

(or)

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

1.2 Lateral Entry Admission

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

(or)

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

2. PROGRAMMES OFFERED

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

B. E. Programmes

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

B. Tech. Programmes

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

3. STRUCTURE OF THE PROGRAMME

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4. VALUE ADDED COURSES / ADD-ON COURSES

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

5. DURATION OF THE PROGRAMME

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

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

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

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

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

6. COURSE ENROLLMENT AND REGISTRATION

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

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

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

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

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

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

6.4 Flexibility to Add or Drop courses

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

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

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

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

6.5 Reappearance Registration

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

8. FACULTY ADVISOR

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

9. COMMITTEES

9.1 Common Course Committee

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

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

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

9.2 Class Committee Meeting

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

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

10. SYSTEM OF EXAMINATION

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

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

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

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

11. PASSING REQUIREMENTS AND PROVISIONS

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

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

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

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

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

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

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

12. ASSESSMENT AND AWARD OF LETTER GRADES

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

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

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

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

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

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

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

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

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

where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

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

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

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

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

13. CLASSIFICATION OF THE DEGREE AWARDED

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

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

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

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

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

14. WITHDRAWAL FROM THE EXAMINATION

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

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

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

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

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

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

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

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

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

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

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

16. SCHEME OF ASSESSMENT

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

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

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

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

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

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

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

VII	**ONE-CREDIT COURSE**	**Marks**
	Test	**30**
	Quiz	**20**
	Final Examination	**50**
	Total Marks	**100**
VIII	**MINI-PROJECT**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Review I	**25**
	Review II	**25**
	Project Evaluation	
	Report (25)#	**50**
	Presentation&Viva Voce (25)	
	Total Marks	**100**
IX	**LIFE SKILLS**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory/Not Satisfactory)	
X	**VALUE ADDED / CERTIFICATE COURSES**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory / Not Satisfactory)	
XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Class work (based on attendance) (5)	
	Assignments (Minimum 8 Assignments) (20)	
	Model Examination (25)	
	End Semester Examination	**50**
	Total Marks	**100**

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

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

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

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

18. PERSONALITY AND CHARACTER DEVELOPMENT

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

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

19. DISCIPLINE

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

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

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

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

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

PART A

Objective Type Questions: 20	**(20X1 = 20 Marks)**	**20**

PART B

Short Answer Questions: 10	**(10X2 = 20 Marks)**	**20**

PART C

Long Answer Questions: 5	**(5X12 = 60 Marks)**	**60**

	Total	**100**

VISION OF THE DEPARTMENT

- To foster academic excellence in Electronics and Communication Engineering Education and Research and turn out students into competent professionals to serve society.

MISSION OF THE DEPARTMENT

1. Establish a unique learning environment and to enable the students to face the challenges in Electronics and Communication Engineering.
2. Provide a framework for professional career, higher education and research activities.
3. Impart ethical and value based education by promoting activities addressing the social needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Design and develop electronic circuits and systems, based on the existing as well as emerging technologies.
II. Pursue higher education, research and continue to learn in their profession.
III. Become a successful professional engineer in Electronics/Communication/allied 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.
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 modelling 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 broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
2. Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

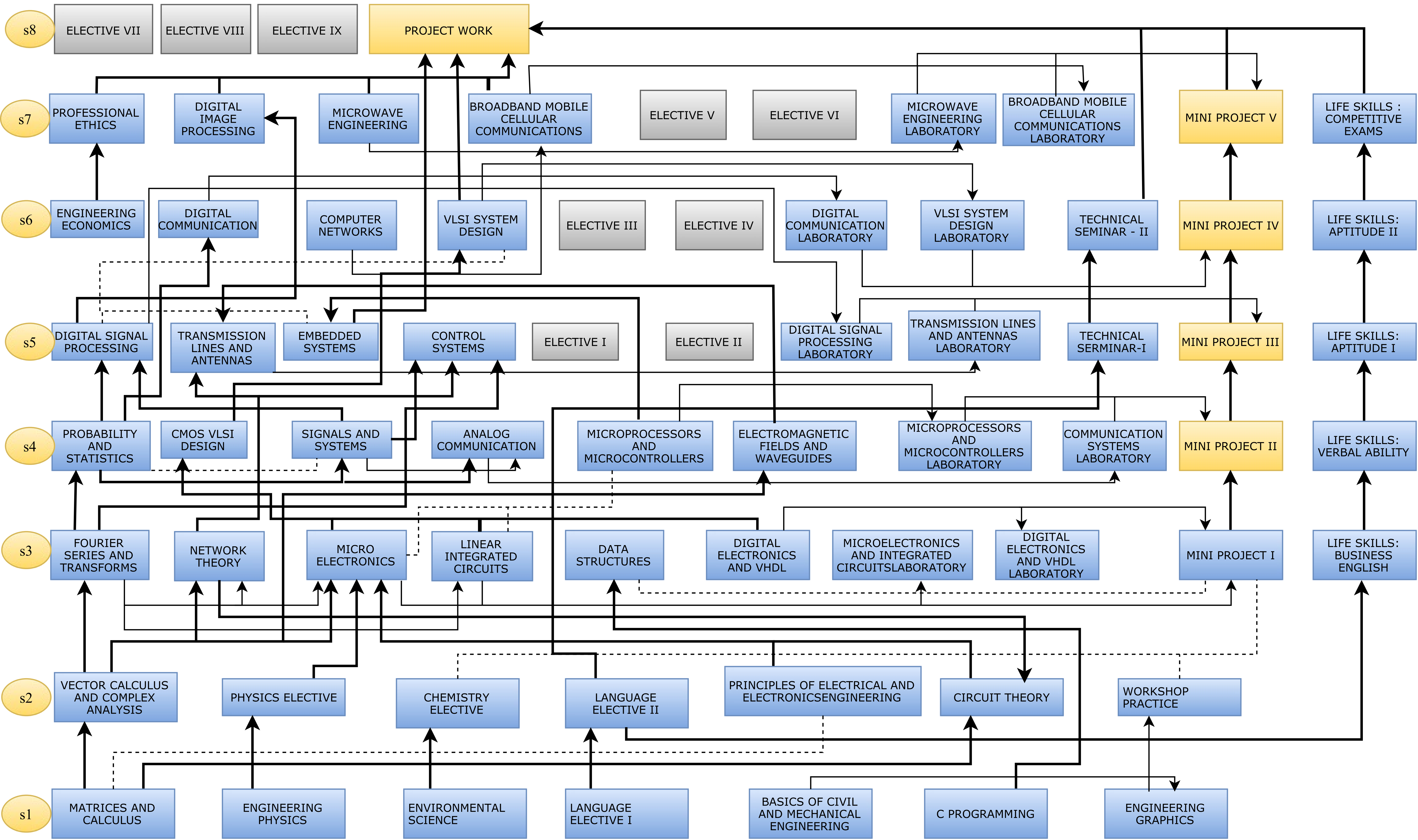
MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)											
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
I			x	x	x	x	x				x	
II	x	x	x	x	x	x			x	x	x	x
III							x	x	x	x	x	x

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM DESIGN & INTERLINKING OF COURSES

GeneralElectives (I to IX) are the courses offered by the departments that do notrequire any kind of prerequisite. It depends upon the students'



CURRICULUM 2015

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

FIRST SEMESTER

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

SECOND SEMESTER

Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA201	VECTOR CALCULUS AND COMPLEX ANALYSIS*	I,II	a,b	3	2	0	4	50	50	100	BS
	PHYSICS ELECTIVE*	-	-	-	-	-	4	50	50	100	BS
	CHEMISTRY ELECTIVE*	-	-	-	-	-	4	50	50	100	BS
	LANGUAGE ELECTIVE II#	II	j	-	-	-	3	100	-	100	HSS
15EC205	PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING	I,III	a,b,c,d,f,k	2	0	2	3	50	50	100	ES
15EC206	CIRCUIT THEORY	I,III	a,b,c	3	2	0	4	50	50	100	ES
15GE107	WORKSHOP PRACTICEΩ	I,II	a,e	0	0	2	1	50	50	100	ES
Total				**8**	**4**	**4**	**23**	**400**	**300**	**700**	**-**

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

THIRD SEMESTER											
Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA301	FOURIER SERIES AND TRANSFORMS$^{\alpha}$	II	a,b	3	2	0	4	50	50	100	BS
15EC302	NETWORK THEORY	I,III	a,b,c,d	3	2	0	4	50	50	100	ES
15EC303	MICROELECTRONICS	I,III	a,b,c,d	3	0	0	3	50	50	100	PC
15EC304	LINEAR INTEGRATED CIRCUITS	I,III	b,c,d,f,g	3	0	0	3	50	50	100	ES
15EC305	DATA STRUCTURES	I,II	a,b,c,d,e	2	0	2	3	50	50	100	ES
15EC306	DIGITAL ELECTRONICS AND VHDL	I,III	b,c,g,i,j,l	3	0	0	3	50	50	100	PC
15EC307	MICROELECTRONICS AND INTEGRATED CIRCUITS LABORATORY	I,III	c,e,f,i,k	0	0	2	1	50	50	100	PC
15EC308	DIGITAL ELECTRONICS AND VHDL LABORATORY	I,III	b,c,d,i,j	0	0	2	1	50	50	100	PC
15EC309	MINI PROJECT I	I,III	a-l	0	0	2	1	100	-	100	EEC
15GE310	LIFE SKILLS: BUSINESS ENGLISH$^{\Phi}$	II,III	j	0	0	2	-	100	-	100	EEC
Total				**17**	**4**	**10**	**23**	**600**	**400**	**1000**	**-**

FOURTH SEMESTER											
Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			Category
		PEOs	POs					CA	ES	Total	
15MA402	PROBABILITY AND STATISTICS	I,II	a,b	2	2	0	3	50	50	100	BS
15EC402	SIGNALS AND SYSTEMS	I,III	a,b,c,e	3	2	0	4	50	50	100	PC
15EC403	ANALOG COMMUNICATION	I,III	b,d,g,j	3	2	0	4	50	50	100	PC
15EC404	MICROPROCESSORS AND MICROCONTROLLERS	I,III	a,b,c,e,g	3	0	0	3	50	50	100	PC
15EC405	CMOS VLSI DESIGN	I,III	b,c,d,e,f	3	0	0	3	50	50	100	PC
15EC406	ELECTROMAGNETIC FIELDS AND WAVEGUIDES	I,III	a,b,d,g	3	2	0	4	50	50	100	PC
15EC407	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	I,III	a,c,d,e,l	0	0	2	1	50	50	100	PC
15EC408	COMMUNICATION SYSTEMS LABORATORY	I,III	b,c,e,f,l	0	0	2	1	50	50	100	PC
15EC409	MINI PROJECT II	I,III	a-l	0	0	2	1	100	-	100	EEC
15GE410	LIFE SKILLS: VERBAL ABILITY$^{\Phi}$	II,III	j	0	0	2	-	100	-	100	EEC
Total				**17**	**8**	**8**	**24**	**600**	**400**	**1000**	**-**

$^{\alpha}$ Common to all branches of B.E./B.Tech. except CSE

$^{\Phi}$ Common to all branches of B.E./B.Tech (Non-Credit Course)

FIFTH SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**POs**					**CA**	**ES**	**Total**	
15EC501	DIGITAL SIGNAL PROCESSING	I,III	a,b,c,g,l	3	2	0	4	50	50	100	PC
15EC502	TRANSMISSION LINES AND ANTENNAS	I,III	a,b,e,f	3	0	0	3	50	50	100	PC
15EC503	EMBEDDED SYSTEMS	I,III	c,d,e	2	0	2	3	50	50	100	PC
15EC504	CONTROL SYSTEMS	I,III	a,b,d,e,f	3	2	0	4	50	50	100	PC
	ELECTIVE I	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE II	-	-	-	-	-	3	50	50	100	PE
15EC507	DIGITAL SIGNAL PROCESSING LABORATORY	I,III	b,c,f,g,l	0	0	2	1	50	50	100	PC
15EC508	TRANSMISSION LINES AND ANTENNAS LABORATORY	I,III	c,d,e,g,i	0	0	2	1	50	50	100	PC
15EC509	TECHNICAL SERMINAR I	II	a,b,d,h,i,j,k,l	0	0	2	1	50	50	100	EEC
15EC510	MINI PROJECT III	I,III	a-l	0	0	2	1	100	-	100	EEC
15GE511	LIFE SKILLS: APTITUDE I$^{\Phi}$	II,III	c,e	0	0	2	-	100	-	100	EEC
Total				**11**	**4**	**12**	**24**	**650**	**450**	**1100**	

SIXTH SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	Maximum Marks			
		PEOs	**POs**					**CA**	**ES**	**Total**	**Category**
15GE701	ENGINEERING ECONOMICS$^{\$}$	I,II	a,f,g,k,l	3	0	0	3	50	50	100	HSS
15EC602	DIGITAL COMMUNICATION	I,III	a,b,c,d,e,f	3	0	0	3	50	50	100	PC
15EC603	COMPUTER NETWORKS	I,III	a,b,c,e	2	0	2	3	50	50	100	PC
15EC604	VLSI SYSTEM DESIGN	I,III	c,e,f,g	3	0	0	3	50	50	100	PC
	ELECTIVE III	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IV	-	-	-	-	-	3	50	50	100	PE
15EC607	DIGITAL COMMUNICATION LABORATORY	I,III	a,b,c,g	0	0	2	1	50	50	100	PC
15EC608	VLSI SYSTEM DESIGN LABORATORY	I,III	a,b,c,d,e,g	0	0	2	1	50	50	100	PC
15EC609	TECHNICAL SEMINAR II	II	b,f,h,j,l	0	0	2	1	50	50	100	EEC
15EC610	MINI PROJECT IV	I,III	a-l	0	0	2	1	100	-	100	EEC
15GE611	LIFE SKILLS: APTITUDE II$^{\Phi}$	II,III	a,b	0	0	2	-	100	-	100	EEC
Total				**11**	**0**	**12**	**22**	**650**	**450**	**1100**	**-**

$^{\Phi}$ Common to all branches of B.E./B.Tech (Non-Credit Course)

$^{\$}$ Common to CSE,ECE,EEE,EIE,IT (VI Semester) and to AE, AG,AU,CE,ME,MTRS,BT,FT,TT, FD (VII Semester)

SEVENTH SEMESTER											
Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			
		PEOs	POs					CA	ES	Total	Category
15GE601	PROFESSIONAL ETHICS+	I,III	h,j,k	2	0	0	2	50	50	100	HSS
15EC702	DIGITAL IMAGE PROCESSING	I,III	e,f,g,k,l	3	0	2	4	50	50	100	PC
15EC703	MICROWAVE ENGINEERING	I,III	a,b,e,g	3	0	0	3	50	50	100	PC
15EC704	BROADBAND MOBILE CELLULAR COMMUNICATIONS	I,III	f,g,j,l	3	0	0	3	50	50	100	PC
	ELECTIVE V	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VI	-	-	-	-	-	3	50	50	100	PE
15EC707	MICROWAVE ENGINEERING LABORATORY	I,III	a,b,e	0	0	2	1	50	50	100	PC
15EC708	BROADBAND MOBILE CELLULAR COMMUNICATIONS LABORATORY	I,III	a,b,e,f,g	0	0	2	1	50	50	100	PC
15EC709	MINI PROJECT V	I,III	a,b,c,f,g,i,j	0	0	2	1	100	-	100	EEC
15GE710	LIFE SKILLS : COMPETITIVE EXAMS$^{\Phi}$	II,III	a,b,l	0	0	2	-	100	-	100	EEC
Total				**11**	**0**	**10**	**21**	**600**	**400**	**1000**	**-**

EIGHT SEMESTER											
Code No.	Course	Objectives & Outcomes		L	T	P	C	Maximum Marks			
		PEOs	POs					CA	ES	Total	Category
	ELECTIVE VII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VIII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IX	-	-	-	-	-	3	50	50	100	PE
15EC804	PROJECT WORK	I,II,III	a-l	-	-	-	9	50	50	100	EEC
Total				**-**	**-**	**-**	**18**	**200**	**200**	**400**	**-**

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

$^{\Phi}$ Common to all branches of B.E./B.Tech (Non-Credit Course)

Electives							
Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
LANGUAGE ELECTIVES							
15LE101	BASIC ENGLISH I	II	j	3	0	0	3
15LE102	COMMUNICATIVE ENGLISH I	II	j	3	0	0	3
15LE201	BASIC ENGLISH II	II	j	3	0	0	3
15LE202	COMMUNICATIVE ENGLISH II	II	j	3	0	0	3
15LC203	CHINESE	II	j	3	0	0	3
15LF203	FRENCH	II	j	3	0	0	3
15LG203	GERMAN	II	j	3	0	0	3
15LH203	HINDI	II	j	3	0	0	3
15LJ203	JAPANESE	II	j	3	0	0	3
PHYSICS ELECTIVES							
15PH201	PHYSICS OF MATERIALS	I	a,b,i	3	0	2	4
15PH202	APPLIED PHYSICS	I	a,b.i	3	0	2	4
15PH203	MATERIALS SCIENCE	I	a	3	0	2	4
15PH204	PHYSICS OF ENGINEERING MATERIALS	I	a	3	0	2	4
15PH205	SOLID STATE PHYSICS	I	a	3	0	2	4
CHEMISTRY ELECTIVES							
15CH201	ENGINEERING CHEMISTRY	I	a,b,d	3	0	2	4
15CH202	APPLIED CHEMISTRY	I	a,b,c,d	3	0	2	4
15CH203	APPLIED ELECTROCHEMISTRY	I	a,b	3	0	2	4
15CH204	INDUSTRIAL CHEMISTRY	I	a,b	3	0	2	4
15CH205	WATER TECHNOLOGY AND GREEN CHEMISTRY	I	a,b	3	0	2	4
DISCIPLINE ELECTIVES							
15EC001	NANO ELECTRONICS	I,III	a,b,e,f,g	3	0	0	3
15EC002	ORGANISATIONAL BEHAVIOUR AND MANAGEMENT	I,II	h,i,j,k,l	3	0	0	3
15EC003	CONCEPTS OF ENGINEERING DESIGN	I,II	a,b,d,e,f	3	0	0	3
15EC004	ROBOTIC VISION	I,III	a,b,c,d,f,g	3	0	0	3
15EC005	EMBEDDED PROCESSORS AND NETWORKS	I,III	a,b,e,g	3	0	0	3
15EC006	CONSUMER ELECTRONICS	I,III	a,b,g	3	0	0	3
15EC007	AUTOMOTIVE ELECTRONICS	I,III	a,b,e,f	3	0	0	3

15EC008	MEDICAL ELECTRONICS AND INSTRUMENTATION	I,III	a,b,e,f	3	0	0	3
15EC009	ADVANCED DIGITAL SIGNAL PROCESSING	I,III	a,b,f,g	3	0	0	3
15EC010	MEDICAL IMAGE PROCESSING	I,III	a,b,e,f	3	0	0	3
15EC011	MACHINE VISION	I,III	a,b,e,f	3	0	0	3
15EC012	ADVANCED 4G WIRELESS MOBILE COMMUNICATIONS	I,III	a,b,e,f	3	0	0	3
15EC013	WIRELESS AD-HOC AND SENSOR NETWORKS	I,III	a,b,e,g	3	0	0	3
15EC014	WIRELESS NETWORKS	I,III	a,b,d,g	3	0	0	3
15EC015	MOBILE COMPUTING	I,III	a,b,e,f,g	3	0	0	3
15EC016	GRID COMPUTING	I,III	a,b,e,g	3	0	0	3
15EC017	NETWORK SECURITY	I,III	a,b,c,e,f,h	3	0	0	3
15EC018	OPTICAL COMMUNICATION	I,III	a,b,c,g	3	0	0	3
15EC019	SATELLITE COMMUNICATION	I,III	a,b,e,g	3	0	0	3
15EC020	RF SYSTEM DESIGN	I,III	a,b,c,g	3	0	0	3
15EC021	RF MEMS	I,III	a,b,e,g	3	0	0	3
15EC022	BIO MEMS	I,III	a,b,e,g	3	0	0	3
15EC023	RADAR AND NAVIGATION AIDS	I,III	a,b,e,f,g	3	0	0	3
15EC024	MEASUREMENT AND INSTRUMENTATION	I,III	a,b,e,f,g	3	0	0	3
15EC025	SYSTEM-ON CHIP	I,III	a,b,e,f,g	3	0	0	3
15EC026	NETWORK ON CHIP	I,III	a,b,f,g	3	0	0	3
15EC027	APPLIED SOFT COMPUTING	I,III	a,b,e,f,g	3	0	0	3
15EC028	PATTERN RECOGNITION & ARTIFICAL INTELLIGENT TECHNIQUES	I,III	a,b,e,f,g	3	0	0	3
15EC029	AUTOMOTIVE SYSTEM DESIGN AND NETWORKING	I,II,III	a,b,c,d,g,m,n	3	0	0	3
15EC030	WIRELESS CELLULAR AND LTE 4G BROADBAND	I,III	a,b,e,f,g	3	0	0	3
15EC031	MACHINE LEARNING	I,III	a,b,e,f,g	3	0	0	3
15EC032	VIRTUAL INSTRUMENTATION	I,III	a,b,e,f,g	3	0	0	3
ENTREPRENEURSHIP ELECTIVES							
15GE001	ENTREPRENEURSHIP DEVELOPMENT I	II	b,c,d,e,f & k	3	0	0	3
15GE002	ENTREPRENEURSHIP DEVELOPMENT II	II	b,e,h,i,j & k	3	0	0	3
PHYSICAL SCIENCE ELECTIVES							
15GE0P1	NANOMATERIALS SCIENCE	I,II	a	3	0	0	3
15GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	I,II	a	3	0	0	3
15GE0P3	APPLIED LASER SCIENCE	I,II	a	3	0	0	3
15GE0C1	CORROSION SCIENCE	I,II	a	3	0	0	3

15GE0C2	ENERGY STORING DEVICES AND FUEL CELLS	I,II	a	3	0	0	3
15GE0C3	POLYMER CHEMISTRY AND PROCESSING	I,II	a	3	0	0	3
OPEN ELECTIVES							
15EC0YA	4G AND BEYOND	I,III	a,b,c,f,g	3	0	0	3
15EC0YB	MEDICAL APPLICATIONS OF LASER	I,III	a,b,e,g	3	0	0	3
15EC0YC	TELEMEDICINE	I,III	a,c,e,f,g	3	0	0	3
15EC0YD	TRANSDUCERS AND INSTRUMENTATION	I,III	a,b,c,e,g	3	0	0	3
15EC0YE	MEMS DESIGN	I,III	a,b,c	3	0	0	3
ONE CREDIT COURSES							
15EC0XA	SYSTEM ON CHIP DESIGN AND CDC TECHNIQUES	I,II	b,c,f	0	0	0	1
15EC0XB	PROGRAMMABLE LOGIC CONTROLLERS (PLC) PROGRAMMING	I,II	b,e	0	0	0	1
15EC0XC	SDR - SOFTWARE DEFINED RADIO	I,II	b,d,g	0	0	0	1
15EC0XD	EMBEDDED SYSTEMS WITH C AND GNU DEVELOPMENT TOOLS	I,II	c,e	0	0	0	1
15EC0XE	ADVANCED VERIFICATION METHODOLOGIES	I,II	b,c	0	0	0	1
15EC0XF	AUTOMOTIVE - TRANSMISSION ELECTRONICS	I,II	b,d	0	0	0	1
15EC0XG	EMBEDDED SYSTEMS DESIGN USING MSP430	I,II	b,e,g	0	0	0	1
15EC0XH	LTE TECHNOLOGY	I,II	b,f	0	0	0	1
15EC0XI	EMBEDDED SYSTEMS DESIGN USING ARDUINO HARDWARE AND IDE	I,II	c,e	0	0	0	1
15EC0XJ	REAL TIME DATA ACQUISITION AND SIGNAL PROCESSING USING LABVIEW	I,II	b,c	0	0	0	1
15EC0XK	EMBEDDED SYSTEM DESIGN USING ARM CORTEXM4	I,II	c,e	0	0	0	1
15EC0XL	MICROWAVE/RF CIRCUIT DESIGN INCLUDING 3D EM MODELING	I,II	b,e	0	0	0	1
15EC0XM	APPLICATIONS OF ANN AND FUZZY LOGIC	I,II	c,e	0	0	0	1
15EC0XN	TEST ENGINEERING	I,II	c,e	0	0	0	1
15EC0XO	EMBEDDED PROTOCOLS	I,II	c,e	0	0	0	1
15EC0XP	INTERNET OF THINGS	I,II	b,c,d	0	0	0	1
15EC0XQ	REAL TIME OPERATING SYSTEM	I,II	b,e,g	0	0	0	1
15EC0XR	M2M FOR SMART CITIES	I,II	a,b,d	0	0	0	1
ADDITIONAL ONE CREDIT COURSES (I to III Semesters)							
15GE0XA	HEALTH AND FITNESS	-	-	-	1	-	-
15GE0XB	FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY	-	-	-	1	-	-
15GE0XC	VEDIC MATHEMATICS	-	-	-	1	-	-

15GE0XD	INTRODUCTION TO ALGORITHMS	-	-	-	1	-	-
15GE0XE	ETYMOLOGY	-	-	-	1	-	-
15GE0XF	HINDUSTANI MUSIC	-	-	-	1	-	-
15GE0XG	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	-	1	-	-
15GE0XH	AGRICULTURE FOR ENGINEERS	-	-	-	1	-	-
15GE0XI	INTRODUCTION TO DATA ANALYSIS USING SOFTWARE	-	-	-	1	-	-
15GE0XJ	ANALYSIS USING PIVOT TABLE	-	-	-	1	-	-
15GE0XK	LOGICAL FRAMEWORK APPROACH	-	-	-	1	-	-
15GE0XL	INTERVIEW SKILLS	-	-	-	1	-	-
15GE0XM	NSS-COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	-	-	-	1	-	-
15GE0XN	JOURNALISM AND MASS COMMUNICATION	-	-	-	1	-	-
15GE0XO	VISUAL MEDIA AND FILM MAKING	-	-	-	1	-	-
15GE0XP	YOGA FOR HUMAN EXCELLENCE	-	-	-	1	-	-
15GE0XQ	CARNATIC MUSIC	-	-	-	1	-	-
15GE0XR	GENERAL PSYCHOLOGY	-	-	-	1	-	-
15GE0XS	NEUROBEHAVIORAL SCIENCE	-	-	-	1	-	-
BRIDGE COURSES							
15ECB01	PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING						
15ECB02	CIRCUIT THEORY						
VALUE ADDED COURSES							
15ECV01	EMBEDDED SYSTEM DESIGN USING 8051 & ARDUINO						
15ECV02	DIGITAL IC DESIGN & IMPLEMENTATION						
15ECV03	ELECTRONIC RAPID PROTOTYPING						
15ECV04	PIC AND MSP430 MICROCONTROLLERS						
15ECV05	PROGRAMMABLE LOGIC CONTROLLERS						
15ECV06	JAVA PROGRAMMING						
15ECV07	OBJECT ORIENTED PROGRAMMING C++						
15ECV08	RF CIRCUIT DESIGN USING ADS						
15ECV09	INTERACTIVE APPLICATIONS IN MATLAB GUI AND SIMULINK						
15ECV10	RFID INTERFACING WITH PIC16F877A						
15ECV11	MATLAB APPLICATIONS IN ENGINEERING						

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	7	12	4	3	-	-	-	-	26	15	15%	20%
2	ES	9	8	10	-	-	-	-	-	27	15	15%	20%
3	HSS	6	3	-	-	-	3	2	-	14	8	5%	10%
4	PC	-	-	8	20	16	11	12	-	67	38	30%	40%
5	PE	-	-	-	-	6	6	6	9	27	15	10%	15%
6	EEC	-	-	1	1	2	2	1	9	16	9	10%	15%
Total		22	23	23	24	24	22	21	18	177	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course

CA - Continuous Assessment
ES - End Semester Examination

15MA101 MATRICES AND CALCULUS 3 2 0 4

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

MATRICES

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

UNIT II **8 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER

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

UNIT III **11 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

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

UNIT IV **9 Hours**

MULTIVARIABLE CALCULUS

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

UNIT V **8 Hours**

MULTIPLE INTEGRALS

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

FOR FURTHER READING

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

Total: 75 Hours

Reference(s)

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

Assessment Pattern

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

Assessment Questions

Remember

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

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

Understand

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

Apply

1. Carry-out the three engineering applications of eigen value of a matrix.
2. Find the Eigen values and Eigen vectors of the matrix A = $\begin{pmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{pmatrix}$ and hence find the

Eigen values of A^2, 5A and A^{-1} using properties.

3. Use Cayley Hamilton theorem to find inverse of A = $\begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$.
4. Find the points of the function $f(x,y) = x^2 y + xy^2 - axy$ where f is a maximum or minimum.
5. A body originally at 80^0C cools down to 60^0C in 20 minutes, the temperature of the air being 40^0C. what will be the temperature of the body after 40 minutes from the original?
6. If the temperature of a cake is 300^0F when it leaves the oven and is 200^0F 10 minutes later, when will it be practically equal to the room temperature of 60^0F, say, when will it be 61^0F? Use Newton's law of cooling.
7. In an L-C-R circuit, the change q on a plate of a condenser is given by $L\frac{d^2q}{dt^2}+R\frac{dq}{dt}\frac{q}{c}$=Esinpt, where i=$\frac{dq}{dt}$.the circuit is tuned to resonance so that p^2=1/LC. If initially the current I and the charge q be zero. Showthat, for small values of R/L, the current in the circuit at time t is given by (Et/2L) sinpt.
8. Construct the solution for the equation $(D^3 - D)y = xe^x$
9. Use the method of variation of parameters to solve $(D^2+4)y = \cot 2x$.
10. Construct the equation $x^2y'' + xy' = x$ into a linear differential equation with constant coefficients.

Analyze:

1. Justify whether the matrix B = $\begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$ is orthogonal or not?
2. Suppose that in winter the day time temperature in a certain office building is maintained at 70°F, The heating is shut off at 10 P.M. and turned on again at 6 A.M. On a certain day the temperature inside the building at 2 A.M. was found to be 65°F. The outside temperature was 50°F at 10 P.M. and had dropped to 40°F by 6 A.M. Find the temperature inside the building when the heat was turned on at 6 A.M.?
3. Experiment show that the radioactive substance decomposes at a rate proportional to the amount present. Starting with 2grms at time t=0 find the amount available at a later time.
4. Differentiate RL and RC electric circuit.
5. Transform the equation $x^2y'' + xy' = x$ into a linear differential equation with constant coefficients.
6. If the voltage in the RC circuit is E = E_0 cos ωt, find the charge and the current at time t.
7. Solve $(x^2D^2-2xD+2)y = (3x^2-6x+6)e^x$, y(1) = 2 +3e, $y'(1)$ =3e

8. In a circuit the resistance is 12Ω and the inductance is 4 H. The battery gives a constant voltage of 60 V and the switch is closed when t = 0, so the current starts with I(0) = 0. (a) Find I(t) (b) Find what happens to the current after a long time justify the current after 1 s.
9. If $g(x, y)=\psi(u,v)$ where $u = x^2 - y^2,\ v = 2xy$ prove that $\frac{\partial^2 g}{\partial x^2}+\frac{\partial^2 g}{\partial y^2}=4(x^2+y^2)\left(\frac{\partial^2\psi}{\partial u^2}+\frac{\partial^2\psi}{\partial v^2}\right)$
10. Solve $\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-x^2-y^2}} xdxdydz$.

Evaluate:

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

15PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **8 Hours**

PROPERTIES OF MATTER

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

UNIT II **6 Hours**

APPLIED OPTICS

Interference: air wedge- theory- uses- testing of flat surfaces- thickness of a thin wire. Laser: introduction-principle of laser- characteristics of laser- types: CO_2 laser -semiconductor laser (homo junction). Fiber optics: principle of light transmission through fiber- expression for acceptance angle and numerical aperture- types of optical fibers (refractive index profile and mode)- fiber optic communication system (block diagram only).

UNIT III **5 Hours**

ULTRASONICS

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

UNIT IV **5 Hours**

SOLID STATE PHYSICS

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

UNIT V **6 Hours**

QUANTUM MECHANICS

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

FOR FURTHER READING

Neutrions - expanding universe

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

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

3 **4 Hours**

EXPERIMENT 2

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

4 **4 Hours**

EXPERIMENT 3

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

5 **4 Hours**

EXPERIMENT 4

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

6 **4 Hours**

EXPERIMENT 5

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

7 **4 Hours**

EXPERIMENT 6

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

8 **4 Hours**

EXPERIMENT 7

Determine the

(i) wavelength of ultrasonics in a liquid medium,

(ii) velocity of ultrasonic waves in the given liquid

(iii) compressibility of the given liquid using ultrasonic interferometer.

Total: 60 Hours

Reference(s)

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

Assessment Pattern

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

Assessment Questions

Remember

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

Understand

1. Explain the procedure adopted for determining the Young's modulus of the given material by non-uniform bending method
2. Illustrate the effect of temperature on elasticity of a material
3. Classify the fiber optics based on refractive index profile
4. Indicate the role of optical resonators in the production of laser

5. Compare the merits of magnetostriction and piezo-electric oscillators
6. Summarize the four applications of ultrasonic waves in day-today life
7. Identify the closely packed cubic crystal structure with an example
8. Compare Laue method and powder crystal method used in X-ray diffraction
9. Infer the significance of photoelectric effect
10. Represent the two assumptions involved in solving the Schrödinger time dependent wave equation

Apply

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

Analyse

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

Evaluate

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

15CH103 ENVIRONMENTAL SCIENCE 2 0 2 3

Course Objectives

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

Programme Outcomes (POs)

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

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

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **6 Hours**

NATURAL RESOURCES

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

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

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

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

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

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

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

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

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

FOR FURTHER READING

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

1 **2 Hours**

EXPERIMENT 1

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

2 **4 Hours**

EXPERIMENT 2

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

3 **4 Hours**

EXPERIMENT 3

Estimation of chloride content in water by argentometric method

4 **4 Hours**

EXPERIMENT 4

Estimation of calcium in lime by complexometric method

5 **4 Hours**

EXPERIMENT 5

Estimation of chromium in leather tannery effluents

6 **4 Hours**

EXPERIMENT 6

Determination of percentage purity of washing soda

7 **4 Hours**

EXPERIMENT 7

Estimation of heavy metals in the given solution by EDTA method

8 **4 Hours**

EXPERIMENT 8

Determination of Prussian blue dye concentration by spectrophotometer

Total: 60 Hours

Reference(s)

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

Assessment Pattern

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

Assessment Questions

Remember

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

Understand

1. Summarize the structural and functional attributes of an ecosystem.
2. With the help of neat flow chart explain waste water treatment process using activated sludge process.
3. Explain the modern method of rain water harvesting technique diagrammatically and discuss the various strategies adopted for water conservation.
4. Summarize the abstracts of Wildlife (protection) Act, 1972.
5. Indicate the three consequences of noise pollution.
6. Classify the ecosystems on the basis of energy sources

7. Infer two types of photochemical reactions involved in formation and destruction of ozone in the stratosphere.
8. Explain how the impacts of natural disasters can be minimized on human communities with on representative example.
9. Summarize four major effects caused on forests and tribal people due to big dam construction.
10. Infer the any two conflicts over water, confining to our nation.
11. Identify three major threats to Indian biodiversity
12. Relate the concept of food chain and food web with tropic level and mention their three significances.

Apply

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

Analyse

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

Evaluate

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

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

Course Objectives

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

Programme Outcomes (POs)

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

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION TO CIVIL ENGINEERING

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

UNIT II **7 Hours**

GENERAL FEATURES RELATING TO BUILDINGS

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

UNIT III **7 Hours**

WATER SUPPLY AND TRANSPORTATION SYSTEMS

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

UNIT IV **8 Hours**

ENGINEERING MATERIALS AND MANUFACTURING PROCESSES

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

UNIT V **8 Hours**

INTERNAL COMBUSTION ENGINES AND REFRIGERATION

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

UNIT VI **8 Hours**

ENERGY, BOILERS, TURBINE AND POWER PLANTS

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

Total: 45 Hours

Reference(s)

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

Assessment Pattern

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

Assessment Questions

Remember

1. Classify Boiler.
2. What are the uses of high carbon steel?
3. Define welding
4. Define soldering.
5. Define Brazing.
6. What do you mean by milling?
7. Classify IC Engines.
8. List the various components of IC Engines.
9. Define Refrigeration.
10. Classify Boiler.

11. What is turbine?
12. Define water tube boiler.
13. Name the main parts of a turbine.
14. Classify power plants.
15. Writedown the scope of Civil Engineering.
16. Define surveying.
17. List the ingredients of concrete.
18. State the basic principles of survey.
19. What is meant by lintel?
20. Write down the components of buildings.
21. List the functions of foundation.
22. What is meant by bearing capacity of soil?
23. What are the factors to be considered in selection of site?
24. Define gauges.
25. Name the components of permanent way.
26. State the importance of railway.
27. List out the types of bridge.
28. Write down the classification of highway.
29. What do you meant by rain water harvesting
30. What are the factors to be considered in design of green building?

Understand

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

Apply

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

15GE106 C PROGRAMMING 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTORY CONCEPTS

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

UNIT II **7 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement - if else statement - nesting of if else Statement - Switch Statement.

Decision Making and Looping: while statement - do while statement - for statement - Nested for statement

Jump Statements: goto - break - continue - return statement

UNIT III **9 Hours**

ARRAYS AND STRINGS

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

UNIT IV **10 Hours**

FUNCTIONS AND POINTERS

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

UNIT V **10 Hours**

STRUCTURES AND FILES

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

FOR FURTHER READING

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

1 **3 Hours**

EXPERIMENT 1

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

2 **3 Hours**

EXPERIMENT 2

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

3 **3 Hours**

EXPERIMENT 3

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

4 **3 Hours**

EXPERIMENT 4

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

5 **3 Hours**

EXPERIMENT 5

Write a C program to generate the following triangle.

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

6 **3 Hours**

EXPERIMENT 6

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

7 **3 Hours**

EXPERIMENT 7

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

8 **3 Hours**

EXPERIMENT 8

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

9 **3 Hours**

EXPERIMENT 9

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

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

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

10 **3 Hours**

EXPERIMENT 10

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

Total: 75 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013

3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

Assessment Pattern

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

Assessment Questions

Remember

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

Understand

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

Apply

1. Compute the greatest of two numbers using ternary operators in C.
2. Demonstrate the concept of type conversion in C.
3. Implement a C program to find the roots of a quadratic equation using Switch case statement.
4. Implement a C program to check whether a number is prime or not.
5. Compute matrix multiplication using two dimentional arrays in C.
6. Execute a C program to check whether a string is a palindrome or not.
7. Implement a C program using functions to find factorial of a number.
8. Implement a C program to use pointers in C.

9. Execute a C program to generate a pay slip for an employee using structures.
10. Implement a C program to copy the content of one file to the other.

Analyse

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

Evaluate

1. Determine the output of the following code.
```
#include
int main()
{
int var = 010;
printf("%d", var);
}
```
2. Determine the value of the logical expression a>b && a
3. Determine the output of the C code
```
#include
int main()
{
int a[5] = {5, 1, 15, 20, 25};
int i, j, m;
i = ++a[1];
j = a[1]++;
m = a[i++];
printf("%d, %d, %d", i, j, m);
return 0;
}
```
4. Determine the output of this C code.
```
#include
int main()
{
int a = 10, b = 10;
if (a = 5)
b--;
printf("%d, %d", a, b--);
}
```
5. Evaluate the expression c=(a+b*(c/d)%e) wih a=10, b=3, c=5, d=6 and e=1

Create

1. Generate a structure to store the following details: Rollno, Name, Mark1, Mark2, Mark3, Total, Average, Result and Class. Write a program to read Rollno, name and 3 subject marks. Find out the total, resultÂ and class as follows:
   a) Total is the addition of 3 subject marks.
   b) Result is "Pass" if all subject marks are greater than or equal to 50 else "Fail".
   c) Class will be awarded for students who have cleared 3 subjects
   i. Class "Distinction" if average >=75
   ii. Class "First" if average lies between 60 to 74 (both inclusive)

iii. Class "Second" if average lies between 50 & 59 (both inclusive)
d) Repeat the above program to manipulate 10 students' details and sort the structures as per rank obtained by them.

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

15GE207 ENGINEERING GRAPHICS 0 0 4 2

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

1 **12 Hours**

CONVENTIONS AND BASIC DRAWINGS

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

2 **14 Hours**

ORTHOGRAPHIC PROJECTIONS

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

3 **12 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACE

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

4 **12 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTIONS

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

5 **10 Hours**

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

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

Total: 60 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, BUREAU OF INDIAN STANDARDS-SP46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V.Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

6. George Omura, Brian C. Benton, Mastering AutoCAD 2015 and AutoCAD LT 2015: Autodesk Official Press, Wiley Publisher, 2015.

15MA201 VECTOR CALCULUS AND COMPLEX ANALYSIS 3 2 0 4

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **10 Hours**

VECTOR CALCULUS

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

UNIT II **9 Hours**

INTEGRAL THEOREMS OF VECTOR CALCULUS

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

UNIT III **8 Hours**

ANALYTIC FUNCTIONS

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

UNIT IV **8 Hours**

MAPPING OF COMPLEX FUNCTIONS

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

UNIT V **10 Hours**

INTEGRATION OF COMPLEX FUNCTIONS

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

FOR FURTHER READING

Applications to Electrostatic and Fluid Flow.

Total: 75 Hours

Reference(s)

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

Assessment Pattern

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

Assessment Questions

Remember

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

Understand

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

Apply

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

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

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

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

Analyze

1. Conclude $div\, grad(r^n)=\nabla^2(r^n)=n(n+1)\,r^{n-2}$.
2. Demonstrate the irrotational vector and solenoidal vector with an example.
3. Justify stokes's theorem for $\overline{F}=-yi+2yzj+y^2k$, where S is the upper half of the sphere $x^2+y^2+z^2=1$.
4. Justify Gauss divergence theorem for $\vec{F}=x^2\,\vec{i}+y^2\,\vec{j}+z^2\,\vec{k}$ where S is the surface of the cuboid formed by the planes x= 0, x= a, y = 0, y = b, z = 0 and z = c.
5. The complex potential f(z)=z^2 describes a flow with constant equipotential lines and streamlines ,Determine the velocity vector.
6. Show that the function $u=x^3+x^2-3xy^2+2xy-y^2$ is harmonic and find the corresponding analytic function.
7. Find the image of the rectangle whose vertices are (0,0), (1,0), (1,2), (0,2) by means of linear transformation w = (1+i)z+2-i. Also compare the images.
8. Generate $f(z)=\frac{z}{(z-1)(z-3)}$ as Laurent's series valid in the regions: $1<|z|<3$ and $0<|z-1|<2$
9. Use Cauchy's integral formula Compute $\int_C \frac{e^z\,dz}{(z+2)\,(z+1)^2}$ where C is the circle $|\,z\,|=3$.
10. Find $\int_C \frac{z+4}{z^2+2z+5}dz$ where C is $|z+1+i|=2$.

Evaluate

1. Determine $\iint_s (xdydz+2ydzdx+3zdxdy)$, where s is the closed surface of the sphere $x^2+y^2+z^2=a^2$
2. Prove that $curl(curl\vec{F})=grad(div\vec{F})-\nabla^2\vec{F}$.
3. Check Stokes theorem for $\vec{F}=\left(x^2+y^2\right)\vec{i}-2xy\vec{j}$ taken around the rectangle bounded by x=±a,y=0 y=b.
4. Check Green's theorem in the plane to determine $\int_c \left(3x^2-8y^2\right)dx+\left(4y-6xy\right)dy$ where c is the boundary of the region defined by $(i)\,x=0,\,y=0,\,x+y=1\,(ii)\,y=\sqrt{x}\;and\;y=x^2$.
5. Determine the analytic function f (z) = P + iQ, if Q = $\frac{\sin x\sinh y}{\cos 2x+\cosh 2y}$, if f(0) = 1.
6. Determine f (z) and the conjugate harmonic v such that w = u + i v is an analytic function of z given that u = $e^{x^2-y^2}\cos 2xy$.

7. Determine the image of the infinite strip $\frac{1}{4} \le y \le \frac{1}{2}$ under the transformation w = $\frac{1}{z}$

8. Determine the Laurent's series expansion $f(z) = \frac{z-1}{(z+2)(z+3)}$ $\quad for \; 2 < |z| < 3$.

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

10. Using Cauchy's integral formula determine $\int_C \frac{e^z dz}{(z+2)(z+1)^2}$ where C is $|Z| = 1$.

15EC205 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of transistors and Power 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.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Compute the DC and AC parameters of the simple electrical circuits using basic laws.
2. Characterize the operations of DC generator, motor and transformer with EMF equations
3. Apply PN diode, zener diode in rectifiers, regulator applications respectively and analyze its performance
4. Describe the working of Bipolar Junction Transistors with 3 different configurations and analyze the transistor as an amplifier and a switch.
5. Explain the construction and characteristics of JFET, MOSFET, UJT-SCR and the transistor equivalent model of DIAC and TRIAC.

Articulation Matrix

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

UNIT I **6 Hours**

ELECTRICAL CIRCUITS

Definition of Voltage, Current, Power & Energy, Ohms law, Kirchoffs Law & its applications simple problems, series & parallel circuits, generation of alternating EMF, definition of RMS value, average value, peak factor, form factor

UNIT II **6 Hours**

ELECTRICAL MACHINES

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

UNIT III **6 Hours**

SEMICONDUCTOR DIODES AND ITS APPLICATIONS

PN junction Diode- Characteristics- Current Equation- -Half Wave Rectifiers - Full waveRectifiers- efficiency, Ripple factor, form factor, Clippers and Clampers- Zener diode- Zener diode as voltage regulator-LED

UNIT IV **6 Hours**

BIPOLAR JUNCTION TRANSISTOR

Structure and working of bipolar junction transistor , CB, CC, CE configurations, relation between alpha and beta, Concept of transistor as an amplifier and transistor as a switch - potential divider biasing, DC load line and Q point.

UNIT V **6 Hours**

FIELD EFFECT TRANSISTOR AND POWER DEVICES

Field Effect Transistors: Construction and characteristics of JFET- parameters of JFET-MOSFET - Depletion & enhancement modes, Construction, Theory of operation & characteristics of UJT-SCR characteristics and two transistor equivalent model, DIAC and TRIAC

FOR FURTHER READING

Tunnel diode,Varactordiode ,PIN diode use of transistor to switch LED, Laser diode, Photodiode, Optocoupler

1 **6 Hours**

EXPERIMENT 1

Generator and motor characteristics

2 **6 Hours**

EXPERIMENT 2

PN Junction and zener diode characteristics

3 **6 Hours**

EXPERIMENT 3

Clipper and clamper circuits

4 **6 Hours**

EXPERIMENT 4

Characteristics of BJT

5 **6 Hours**

EXPERIMENT 5

Characteristics of FET and UJT

Total: 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford Press, 2011.
2. R. Muthusubramaninan, S. Salivahanan and K. A. Muraleedharan, Basic Electrical, Electronics andComputer Engineering, Tata McGraw Hill, 2006.
3. J Millman, C. Halkias&Satyabrata JIT "Electronic Devices and Circuits", Tata McGraw-Hill,2010
4. L Robert Boylestead, Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education 2012.
5. J. A. Edminister, Electric Circuits,Schaum's Series, McGraw

Assessment Pattern

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

Assessment Questions

Remember

1. Define current and voltage
2. Define form factor and peak factor of a wave.
3. Give the voltage transformation ratio of a transformer.
4. List the four types of clipper.
5. Define Back EMF.
6. Define depletion layer and barrier potential of a PN junction diode.
7. Define Q point.
8. List the configurations of BJT
9. Draw the Symbols of (a) SCR (b) TRIAC (c) DIAC (d) LED
10. List the applications of FET.

Understand

1. State Kirchoff's current law
2. Define Power and Energy.
3. State Faraday's laws of electromagnetic induction.
4. How does avalanche breakdown occurs?
5. State the principle of mutual inductance.
6. Differentiate between clipper and clamper.

7. Draw the symbol of NPN and PNP transistor
8. Define current gain.
9. Why FET is used mostly rather than BJT?
10. Draw the equivalent circuit of SCR.

Apply

1. A light bulb uses 300 W for 240 minutes. Calculate the amount of energy in KWH.
2. When a resistor is placed across a 230 V supply, the current is 12A. What is the value of the resistor that must be placed in parallel to increase the load to 16A.
3. Calculate the e.m.f. generated by a 4 pole wave wound generator having 65 solts with 12 conductors per slot when driven at 1200 r.p.m. The flux per pole is 0.02wb.
4. Calculate the value of torque established by the armature of a 4 pole motor having 774 conductors, two paths in parallel, 24mWb flux per pole, when the total armature current is 50A.
5. Derive the eficiency of half wave rectifier.
6. Derive the eficiency of full wave rectifier.
7. A transistor has an alpha of 0.975. What is the value of ß?
8. A transistor has a typical beta of 100. If the collector is 40mA, what is the value of emitter current?
9. Determine the values of drain current and transconductance at Vgs=-4, Idss=20mA,Vp=-8V and Gmo=5000µs for an n-channel JFET.
10. Draw the equivalent circuit of UJT.

Analyse

1. Differentiate BJT and FET.
2. Differentiate Enhancement and Depletion MOSFET
3. Differentiate between SCR and Triac.
4. Derive Series and Parallel circuits
5. Derive the EMF equation of DC Generator.
6. Discuss the Input and Output characteristics, current gain of a BJT in CB Configuration and explain different regions of operations.
7. Derive the Torque equation of DC Motor.
8. Elucidate the different types of JFET with neat diagrams and its characteristics.

Evaluate

1. Justify Zener diode as a voltage regulator.
2. Elaborate the principle of operationÂ of a PNP Transistor with neat diagrams.
3. Derive the expressions for alpha, β and γ in BJT.

Create

1. Design a circuit to obtain a DC emitter current of 1mA to ensure a ±2V signal swing at the collector with VCE = 2.3 V, VCC = 10V β = 100.
2. Design a Single stage MOS amplifier with overall voltage gain of a common source amplifiers for which transconductance = 2mA/V, ro= 50Kohm RD = 10Kohm, Rg= 10Mohm.

15EC206 CIRCUIT THEORY 3 2 0 4

Course Objectives

- To study the basic laws on Circuits and calculate the voltages and current in circuit using basic theorems.
- To apply the concept of transients and resonance in series and parallel circuit
- To explore Graph theory techniques applied to network topologies.

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.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
Course Outcomes (COs)

1. Apply Voltage-Current laws and transformation techniques to solve linear electric circuits and analyze the phase relationships of circuits with RLC components
2. Apply Graph theory techniques to calculate the voltage and current in an electric circuit
3. Determine the electrical parameters of the circuits by using network theorems
4. Analyze the steady state and transient response of RLC circuit using differential equations and Laplace transform
5. Analyze the frequency response of an electric circuit and apply inductance principle to solve coupled circuits

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

UNIT I **9 Hours**

BASICS OF CIRCUIT ANALYSIS
Basic components and electric circuits, voltage and current laws, Basic mesh and nodal analysis, source transformation techniques, Star delta transformation techniques, Phase relationship for R, L and C. Impedance, Admittance for R, L and C elements

UNIT II **9 Hours**

NETWORK TOPOLOGIES
Concept of Duality, Dual network, Graphs of a network, Trees, twig, link and branches, Incidence matrix, Tie-set matrix formation and cut-set matrix formation of a graph

UNIT III **9 Hours**

NETWORK THEOREMS AND APPLICATIONS
Linearity- Thevenin's theorem - Norton's theorem- Super position theorem- Maximum power transfer theorem- Reciprocity theorem - Compensation theorem- Tellegen's theorem- Millman's theorem.

UNIT IV **9 Hours**

TRANSIENTS

Differential equations / Laplace Transform - Steady state and transient response: DC response of RL, RC and RLC circuit - Sinusoidal response of RL, RC and RLC circuits.

UNIT V **9 Hours**

RESONANCE AND COUPLED CIRCUITS

Resonance: Natural frequency and Damping Ratio - Series Resonance - Parallel Resonance-Quality Factor. Coupled Circuits: Self-inductance- Mutual inductance, Dot conversion-Coupling Coefficient-Ideal Transformer- Tuned Coupled Circuits.

FOR FURTHER READING

Simulation of Circuits and Evaluation of its parameters. Basic Concepts and Definitions, Analysis of Simple Circuits, Nodal and Mesh Equations - Circuit Theorems, Natural Response, Forced and Total Response in RL and RC Circuits.

Total: 75 Hours

Reference(s)

1. William Hayt,JV Jack,E Kemmerly and Steven M Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.
2. Joseph Edminister and MahmoodNahri, Theory and Problems of Electric Circuits Tata McGraw-Hill, 2008.
3. A Sudhakar,S Shyammohan and Palli,Circuits and Network (Analysis and synthesis) Tata McGraw-Hill, 2010.
4. L Robert Boylested, Experiments in Circuit Analysis to Accompany Introductory Circuit Analysis, PHI , 2002.
5. M .Russell, Mersereau and Joel R. Jackson, Circuit Analysis- A System Approach, Pearson Education, 2009.
6. Steven T. Karris, Circuit Analysis I with MATLAB Applications, Orchard Publications, 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				2				6										18
2		2					6				8								8						24
3	2					4				4					4										14
4	2					2					8								8						20
5		2				2				8				4				8							24
																								Total	100

Assessment Questions

Remember

1. Define the term current.
2. List the four classifications of network elements.
3. Define ohm's law.
4. State superposition theorem.
5. State millman's theorem.
6. State maximum power transfer theorem.

7. List the four properties of tree.
8. Define Q factor.
9. Label the voltage and current phase relation of an inductor.
10. Define chord and twig in a graph.
11. State the Kirchhoff's laws.

Understand

1. Differentiate between potential difference and voltage.
2. Sketch the nortan's equivalent circuit.
3. Sketch the thevinens equivalent circuit.
4. Compare the property of inductor and capacitor.
5. Identify the two properties of series and parallel resonance circuits.
6. Compare the procedure for thevinen's and nortons theorem.
7. Formulate that maximum power transfered in a circuit at source resistance is equal to load resistance.
8. Explain the steady state response and transient response.
9. Illustrate the voltage vo for a circuit with dot rule.
10. Infer the output response of series RL circuit with RC circuit.

Apply

1. Find the current in a series circuit with R1 =10 ohm, R2 = 5 ohm and R3 = 5 ohm with supply voltage of 20 V.
2. Use voltage division rule to find the voltage across 10 ohm. The circuit consist of R1 =5 ohm and R2 = 10 ohm with Vs = 5V.
3. Compute the current through R1 and R2 resistor connected in parellel with the Vs source. Use current division rule.
4. Derive an R1 R2 and R3 values for a star connected network to delta connected network.
5. Show that maximum power delivered to the load resistance when Rs = RL.
6. Find the transient current when switch S is closed at time t = 0 for a series RL circuit with R = 10 ohm and L = 1 H with Vs = 10V.
7. Construct an thevinen's equivalent circuit for a circuit having five parellel arm with each of 10 ohm resistance connected with 50 V source.
8. A series circuit with R = 10 ohm, L =0.1 H and C = 50F has an applied voltage of V=50 V with a variable frequency. Find the resonant frequency,Â the value of frequency at which maximum voltage across inductor and capacitor.
9. Calculate the mmf required to produce a flux of 5mwb across an air gap of 2.5mm of length having an effective area of 100 cm2 of cast steel ring of mean iron path of 0.5 m and cross sectional area of 150 cm2 .the relative permeablity of the cast steel is 800. Neglect the leakage flux.
10. Find the voltage across the capacitor and resistor for a series RC circuit has R = 10 ohm and C = 0.1 F Vs = 20V is applied at time t = 0.
11. A series RL circuit with R = 30 ohm and L = 15 H has a constant voltage V = 60 applied at time t = 0. Compare the current (I), the voltage (V) across resistor and inductor with respect to time t = 0-, t = 0 and t = 0+.

Analyse

1. Derive the sinusoidal response of RL and RC circuit and compare its output response with respect to time.
2. Compare and contrast the series and parellel resanance circuits.
3. Use superposition theorem to calculate the current through 10 ohm resistor also determine the current by using mesh analysis.
4. A star connected network has arm resistance R1 = R2 =R3 = 10 ohm Determine its delta arm resistance.
5. Determine the dual of Series R L and C network connected with current source.

Evaluate

1. Use mesh analysis to evaluate the current i1 and i2 for a circuit also verify the result using mesh analysis.
2. Determine the current in a resistor which has 10 ohm resistance with 10 volt voltage source. if R is changed to 12 ohm what will be the change in current.
3. Evaluate the current I1 and I2 for a circuit and evalute the current using dual theorem.
4. Draw a oriented graph of your own and evaluate the mesh current using tieset matrix.
5. Draw the oriented graph and evaluate the cut set matrix for the oriented graph.

Create

1. The circuit in the figure below is used by a biology student to study “frog kick”. She noticed that the frog kicked a little when the switch is closed but kicked violently for 5 sec when the switch was opened. Model a frog as a resistor and calculate its Resistance. Assume that it takes 10 mA for the frog to kick violently.

15GE107 WORKSHOP PRACTICE 0 0 2 1

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Fabricate simple components using carpentry, sheet metal and welding equipment/tools
2. Prepare braided and smocked lifestyle articles and decorative using suitable tools.
3. Make / operate / utilize the craft materials
4. Prepare and fabricate craft components using fitting techniques.
5. Prepare and fabricate craft components using forming techniques.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Design and development of Greeting card and wedding card

2 **4 Hours**

EXPERIMENT 2

Design and development of Warli painting

3 **2 Hours**

EXPERIMENT 3

Design and development of Saree and pillow embroidery

4 **2 Hours**

EXPERIMENT 4

Design and development of wall hangings using various macram knots

5 **4 Hours**

EXPERIMENT 5

Design and development of tea coasters and table mats

6 **4 Hours**

EXPERIMENT 6

Design and development of hand bag

7 **4 Hours**

EXPERIMENT 7

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

8 **4 Hours**

EXPERIMENT 8

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

9 **2 Hours**

EXPERIMENT 9

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

10 **2 Hours**

EXPERIMENT 10

Mini Project(Fabrication of Small Components).

Total: 30 Hours

15MA301 FOURIER SERIES AND TRANSFORMS 3 2 0 4

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

FOURIER SERIES

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

UNIT II **13 Hours**

LAPLACE TRANSFORM

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

UNIT III **8 Hours**

FOURIER TRANSFORM

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

UNIT IV **8 Hours**

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

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

UNIT V **7 Hours**

Z -TRANSFORM

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

FOR FURTHER READING

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

Total: 75 Hours

Reference(s)

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

Assessment Pattern

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

Assessment Questions
Remember

1. State the Dirichlet's Conditions.
2. Define even and odd function graphically.
3. List out the complex Fourier transform pair.
4. State convolution theorem in Fourier transforms.
5. Label the condition for the existence of Laplace Transform.
6. Reproduce L (t sin at).
7. State the final value theorem for Laplace Transform.
8. Label the inverse Laplace Transform of $1/(s^2+w^2)^2$.
9. Recognize $z\{f(n+1)\}$ $in\, terms\, of\ \overline{f}(z)$
10. Recall the Z – Transform of $\cos\left(\frac{n\pi}{2}\right)$

Understand

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

Apply

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

Analyze

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

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

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

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

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

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

Evaluate

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

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

   Find the displacement of the string at any subsequent time.

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

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

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

f(t) = $\left\{\begin{matrix} \sin \omega t & , for\ 0 < t < \pi/\omega \\ 0 & , for\ \pi/\omega < t < 2\pi/\omega \end{matrix}\right\}$

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

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

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

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

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

15EC302 NETWORK THEORY 3 2 0 4

Course Objectives

- To learn the two port network parameters.
- To study the types of filters and its equations.
- To understand the concept of attenuators and equalizers.

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Calculate the input and load impedance /admittance of network functions.
2. Compute ABCD, hybrid and its inverse parameters for a two-port network system.
3. Synthesis of RL , RC and LC networks to find the stability of the system.
4. Design of Low Pass, High Pass, Band Pass and Band Reject filter networks.
5. Design and analysis of different types of attenuators and equalizers.

Articulation Matrix

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

UNIT I **9 Hours**

NETWORK ANALYSIS

Terminal polls - Network functions for one part and two port - Ladder network - General networks - Poles and zeros of network functions- Restrictions on pole and zero Locations for driving point functions and transfer functions - Time domain behaviour from the poles and zero plot.

UNIT II **9 Hours**

TWO PORT PARAMETERS

Inter Relationship of two port variables -Open circuit impedance parameters, short circuit admittance parameters -Transmission (ABCD) and Hybrid (h) parameters- Inverse transmission (A`B`C`D`) and Inverse hybrid (g) parameters-Inter relationships of different parameters- - Interconnection of two-port networks- T and pi representation - Terminated two port network

UNIT III **9 Hours**

NETWORK SYNTHESIS

Hurwitz polynomials - Positive real functions - Synthesis of reactive one port by Foster and Cauer method - Synthesis of RL, RC, and LC networks by Foster and - Cauer methods.

UNIT IV **9 Hours**

FILTERS

Types of filters- Filter networks- Equations of filter networks- Design of constant - K, M- derived low pass and high pass filters- Band pass and band reject filters.

UNIT V **9 Hours**

ATTENUATORS AND EQUALIZERS

Attenuators - T- type attenuator- pi - type attenuator - Lattice Attenuator - Bridged - T attenuator - L Type- Equalizers-Inverse Networks - Series equalizer - Full Series Equalizer- Shunt Equalizer - Full Shunt Equalizer-Constant Resistant Equalizer- Bridged - T Attenuation Equalizer - Bridged- T Phase Equalizer- Lattice Attenuation Equalizer - Lattice phase Equalizer.

FOR FURTHER READING

Interrelationships between the parameters, Lattice networks - Image parameters, Stability of active networks,Simulation of general and ladder network , Simulation of RL, RC, LC network , Simulation of filters design, Simulation of Attenuators & Equalizers.

Total: 75 Hours

Reference(s)

1. M.E. Van Valkenburg., "Networks Analysis ", Prentice Hall of India, 2005.
2. Ravish R Singh, "Electrical networks ", Tata McGraw Hill, 2009.
3. A.Sudhakar and S.P.Shyammohan, "Circuits and Networks - Analysis and Synthesis", Tata McGraw Hill, 2001.
4. UmeshSinha, "Network Analysis and Synthesis", SatyaPrakashan, 1997.
5. FrankelinKuo, "Network analysis & Synthesis", McGrawHiII, 1990.

Assessment Pattern

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

Assessment Questions
Remember

1. Define two ports Network.
2. List the different types of networks.
3. Define poles and zeros of two port network.
4. List the equation for Z, Y, h, T parameters.
5. Whether pole or zero determines the response of a system, why?
6. What are LPF, HPF, BPF and BRF?
7. List two types of attenuators.
8. List two types of equalizers.
9. List Four application oriented example of LPF and HPF
10. Define lattice phase equalizers.

Understand

1. Compare the function of Network analysis and synthesis.
2. Define symmetrical network.
3. Explain foster and cauer methods.
4. Classify four filters.
5. Explain short circuited and open circuited line.
6. Identify whether the polynomial is Hurwitz P(s) = s3+4s2+5s+2.
7. Identify whether the polynomial is Hurwitz P(s) = s3+2s2+4s+2
8. Explain different types of attenuators.
9. Explain different types of equalizers.
10. Represent the poles and zero plot of the following functions F(S)=s(s+2)/(s+1)(s+5).
11. Draw cascade connection for inverse transmission parameters.

Apply

1. Design the equivalent circuit diagram for h-parameter.
2. Draw the equivalent circuit diagram for Z-parameter.
3. Show cascade connection for transmission parameters.
4. Draw parallel connection for two port network.
5. Design series connection for two port network.
6. Draw series- parallel connection for two port network.
7. Draw parallel-series connection for two port network.
8. Draw T and π attenuators circuits.
9. Show series and shunt equalizers.

Analyse

1. Differentiate between network analysis and synthesis.
2. Differentiate between band pass and band stop filter.
3. Obtain the poles and zero plot of the following function F(s)=s(s+2)/(s+1)(s+3).
4. Conclude the necessary and sufficient conditions for positive real functions.
5. Justify how to analyze the two port networks?
6. Justify how to synthesize the RC networks?
7. Compare RC networks and RL networks.
8. Compare RC networks and LC networks.
9. Structure the poles- zero plot of the following functions F(s)=s(s+2)/(s+1).
10. Structure the poles and zero plot of the following functions F(s)=s(s+2)/(s+1)(s+3).

Evaluate

1. Determine the given polynomial is Hurwitz P(s) =S3+3S2+2S+2.

2. Determine the given polynomial is Hurwitz P(s) =S3+3s2+2s+3.
3. Determine the given polynomial is Hurwitz P(s) =S3+3s2+2s+1.
4. Determine the range of values of K if the given polynomial is Hurwitz P(s) =S3+3s2+2s+k.
5. Determine the range of values of K if the given polynomial is Hurwitz P(s) =S4+S3+3s2+2s+k.
6. Check whether the polynomial is Hurwitz P(s) = s3+4s2+5s+2.
7. Check whether the polynomial is Hurwitz P(s) = s4+s3+4s2+5s+2.
8. Check whether the polynomial is Hurwitz P(s) = s3+s2+2s+2.
9. Check whether the polynomial is Hurwitz P(s) = s4+7s3+6s2 +21s+8.
10. Check whether the polynomial is Hurwitz P(s) = s7+3s5+2s3+3.
11. Derive constant K high pass filter.

Create

1. Derive constant K low pass filter.
2. Derive constant M high pass filter.
3. Derive constant M low pass filter.

15EC303 MICROELECTRONICS 3 0 0 3

Course Objectives

- To learn the fundamental concepts behind transistor biasing and to differentiate small signal and large signal circuit models
- To study the performance metrics of Multistage and Power amplifiers
- To understand the working of signal generating and wave shaping circuits

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.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze different biasing methods for Bipolar Junction Transistors and Field Effect Transistors
2. Compare and model different Transistor configurations for Bipolar Junction Transistors and Field Effect Transistors
3. Analyze the behaviour of Bipolar Junction Transistors and Field Effect Transistors at different frequency conditions
4. Design multistage and feedback amplifier circuits using Bipolar Junction Transistors and Field Effect Transistors
5. Design Oscillator and Multivibrator circuits using Bipolar Junction Transistors

Articulation Matrix

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

UNIT I **7 Hours**

TRANSISTOR BIASING

BJT: Operating point, Bias Stability, Collector Feedback bias, Emitter Feedback Bias, Self Bias, Bias Compensation- Thermistor and Sensistor compensation-Thermal Runaway, FET: Biasing by Fixing VGS, Biasing by connecting Resistance, Biasing by Drain to Gate Feedback Resistor, and Biasing using Constant Current Source.

UNIT II **8 Hours**

SMALL SIGNAL LOW FREQUENCY MODELS

BJT: Analysis of transistor amplifier CE,CC&CB Configuration using h parameters , Simplified Hybrid Model for CB, CE & CC configurations, Comparison of transistor amplifier configurations, Darlington Pair. FET: Voltage Gain, Small Signal Equivalent Circuit model.

UNIT III **10 Hours**

HIGH FREQUENCY MODELS

BJT: Behaviour of Transistor at High Frequency, The High Frequency T Model, The Hybrid pi Common Emitter Transistor Model, - CB & CE Short Circuit Current Frequency response, Frequency Response of the CE Amplifier.

UNIT IV **11 Hours**

MULTI STAGE AND FEEDBACK AMPLIFIERS

BJT: CE-CC Amplifier, Cascade Amplifier, RC coupled amplifier, Millers Theorem, High input resistance transistor circuits, Difference Amplifier- Step response and Frequency Response of Multistage Amplifiers. Feedback amplifiers - Current Series, Voltage Shunt, Current shunt and Voltage Series. Power Amplifiers: Class A, Class B, Class C, Class AB and Class D Power Amplifiers, Distortion in Amplifier.

UNIT V **9 Hours**

SIGNAL GENERATORS AND WAVE SHAPING CIRCUITS

Basic Principles of Sinusoidal Oscillators, Classification of Oscillator- Barkhausen Criterion- RC Phase Shift ,Wien Bridge , General Form of LC- Hartley, Colpitts, Clapp Tuned Collector and Crystal Oscillators. Monostable , Astable and Bistable Multivibrators.

FOR FURTHER READING

Collector Emitter Feedback Bias, Bootstrap Darlington Circuit, Effect of Emitter or a Source Bypass Capacitor on Low frequency response, Comparison of Power Amplifiers, BJT Digital Logic Inverter, CMOS Digital Logic Inverter, BiCMOS Cascade Amplifier, Current Mirror Circuits, CMOS Logic Gate Circuits, Power BJTs, Power MOSFETs.

Total: 45 Hours

Reference(s)

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory an Applications ,5th Edition, Oxford University, 2006.
2. Jacob Millman, C. Halkias and Satyabrata Jit Electronic Devices and Circuits, 3rd Edition, Tata McGraw-Hill, 2011
3. Jerry C. Whitaker, Micro Electronics, 2nd Edition, Taylor & Francis, 2006
4. Muhammad H. Rashid , Microelectronic Circuits: Analysis and Design, 2nd Edition, Cengage Learning, 2011
5. Jacob Millman, Arvin Grabel , Microelectronics, 2nd Edition, TATA McGRAW Hill, 1999
6. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.

Assessment Pattern

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

Assessment Questions

Remember

1. Classify power amplifier based on the conduction angle and Q point.
2. List the steps involved in the design of oscillator and amplifier Circuit.
3. List the ideal characteristics of Differentiating Amplifier.
4. List the applications of Class C Amplifier in Electronics System Design.
5. Classify Oscillators based on the principle of operation.
6. Classify Amplifiers based on the region of operations.
7. Draw the circuit diagram showing Sensistor and Thermistor compensation of biasing.
8. Draw the circuit diagram of Darlington pair Amplifier.
9. How Oscillators are classified? List the major types of Oscillators.

Understand

1. List any four advantages of low frequency and high frequency oscillators.
2. Why monostable circuit is called Delay Circuit?

3. Why we need to bias the Transistor Amplifier circuits?
4. How biasing an FET is different from that of BJT?
5. Write the significance of h parameters in Circuit Analysis.
6. How the output is affected in Multistage Amplifiers compared to the Single Stage Amplifiers?
7. Write the role of Barkhausan criteria in the design of Oscillators.
8. How power amplifiers are different from Signal Amplifiers?
9. Write the significance of Millers theorem in Circuit Analysis.
10. Write the significance of Input and Output impedence of Amplifier circuits.

Apply

1. Determine IB, IC and VCE for a base biased transistor circuit with the following values βdc =90, VCC=12V.
2. Calculate the output resistance of BJT for which Voltage gain of 100 at IC = 0.1 and 10mA.
3. Calculate the value of Rb if the transistor is saturated when Vcc = +5 V Vi = 5 V when Rb = Rc= 1Kohm and Beta = 100
4. A class C amplifier has a base bias voltage of -5V and Vcc = 30 V. It is determined that a peak input voltage of 9.8V at 1MHZ is required to drive the transistor to its saturation current of 1.8 A. If the DC current gain of a transistor is 100, determine βdc and αdc? For a given type of transistor, can βdc be considered to be a constant?
5. Which Feedback circuit will you select for a Home made audio amplifier circuit? Justify your answer with neat diagrams.
6. The modern analog circuits are using MOS Difference amplifiers instead of BJT Difference amplifiers. What makes the MOS Difference amplifiers superior to the BJT Difference amplifiers?
7. Why Crystal Oscillators are considered for Microcontroller based circuits?
8. How will you select a Power Amplifier for different applications?
9. Illustrate the use of Difference amplifier in an Op-Amp Circuit.
10. Predict the outcome of using a Class D Amplifier in Audio amplifier circuit.

Analyse

1. Compare Class A, Class B and Class C Amplifiers.
2. Differentiate CE Configuration and CB Configuration of BJT.
3. Outline the characteristics of an ideal Op-Amp.
4. Compare Astable and Monostable Multivibrators.
5. Compare CE, CC, and CB configuration using h parameter analysis.

Evaluate

1. Justify the use of Difference amplifier in Op-Amp for Multivibrator Circuits.
2. Select the best Amplifier configuration for amplifing the output of a Sensor used in medical applications like Patient Monitoring System.
3. Compare the different types of Oscillators and select the best Oscillator that can be used as clock in a Digital Circuit application.
4. Conclude the applications of Feedback Amplifiers in Circuit Design.
5. Explain the working of Hartley and Colpitts Oscialltors.

Create

1. Design a emitter follower circuit with Vcc=10V,I=100ma, and RL=100 ohm. If the output voltage 8 V peak sinusoid find the power delivered th the load.
2. Design a Class B Push Pull amplifier with Vcc = 50V, total power dissipation of 40 W find the conversion efficiency.

15EC304 LINEAR INTEGRATED CIRCUITS 3 0 0 3

Course Objectives

- To demonstrate the IC fabrication steps and basic building blocks of linear integrated circuits.
- To design and analyse the linear and non-linear applications of operational amplifiers.
- To illustrate the operating principle of PLL, Data Converters and various special function ICs.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Illustrate the circuit fabrication process and internal structure of operational amplifiers
2. Characterize and analyze the applications of operational amplifiers.
3. Able to design comparator and generate waveforms using operational amplifier.
4. Analyze the principle and operation of PLL and Data converters.
5. Identify special function ICs and its application in modern electronic equipments.

Articulation Matrix

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

UNIT I **8 Hours**

IC FABRICATION AND OPERATIONAL AMPLIFIER

Introduction to Integrated Circuits- Classification of ICs- Basic IC Fabrication Planar Process- Fabrication of Diode - Operational Amplifier:Basic Information of Op-Amp, Ideal Op Amp- Operational Amplifier Internal Circuit- Differential Amplifier- Analysis of current sources- Current Mirror- Widlar- Wilson Current Source

UNIT II **11 Hours**

CHARACTERISTICS OF OP- AMP AND APPLICATIONS

Characteristics of Op- Amp - DC Characteristics, AC Characteristics - Frequency Response- Frequency Compensation - Slew Rate- Applications: Closed Loop Op Amp Configuration - Inverting and Non inverting Amplifiers- Inverter- Voltage Follower-Summing Amplifier, Averaging Circuits - Subtractor- Differential Amplifier- Multiplier- Differentiator- Integrator- Instrumentation amplifier, Precision rectifier- 1st Order LPF,HPF

UNIT III **8 Hours**

COMPARATOR AND WAVEFORM GENERATORS

Comparators - Open Loop Op Amp Configuration - Inverting , Non Inverting Comparator- Applications of Comparator- Regenerative Comparator (Schmitt trigger) - Waveform Generators - Multivibrators - Astable, Monostable - Triangular wave generator- Principles of Sinewave Oscillator- RC Phase Shift, Wien Bridge Oscillator

UNIT IV **10 Hours**

PHASE LOCKED LOOP AND DATA CONVETER

Block Diagram of PLL- Principles-Types- Phase Detector- Voltage Controlled Oscillator-IC 566 and IC 565 Internal Block Diagram- PLL Applications - Data Converter - Sample and Hold circuits D/A Techniques: Binary Weighted Resistor- R-2R and Inverted R-2R Ladder DAC- A/D converter: Flash - Counter - Successive Approximation Converter -Dual Slope- Applications of Data Converter

UNIT V **8 Hours**

SPECIALIZED IC APPLICATIONS

555 Timer Internal Architecture- Astable and Monostable Multivibrators using 555 Timer -Applications- Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply - Universal Active Filter- Switched Capacitor Filter

FOR FURTHER READING

Log & Antilog Amplifier- Function Generator using Op Amp - Analog Multiplier - Peak Detector - Clipper- Clamper- 1st Order BPF and BSF - Frequency Synthesizer - Specifications of ADC & DAC Converters- Voltage to Time, V/F and F/V Converters- Advanced IC Application: Opto-couplers , Fiber Optic IC- AGC , AVC - PCB design : Design Process & Assembly of Op Amp based circuits using MITS Machine

Total: 45 Hours

Reference(s)

1. RamakantA.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2002.
2. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
3. Sergio Franco, Design with operational amplifiers and analog integrated circuits, McGraw-Hill, 2002.

4. David L.Terrell,Op Amps-Design, Application, and Troubleshooting, Elsevier publications 2005.
5. Taub and Schilling, Digital Integrated Electronics, McGraw-Hill, 1997.
6. William D.Stanely, Operational Amplifiers with Linear Integrated Circuits. Pearson Education, 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		2	2		2		8				6														20
2	2					2			4									8				8			24
3														4			2	8				8			22
4		2	4			2	8							4											20
5			6		8																				14
																								Total	100

Assessment Questions
Remember
1. Define CMRR.
2. List out various configurations of a differential amplifier.
3. Define slew rate.
4. Mentions some real time applications of Op Amp.
5. Define Multivibrator.
6. Recognise the functional blocks of a PLL.
7. Recall the Pin Configuration of SE566.
8. State Sampling Theorem.
9. Mention the types of DAC's and ADC's.
10. Recall the functions of 555 Integrated circuits.
11. Retrive the properties of Voltage Regulator IC.

Understand
1. Compare linear and non-linear integrated circuits.
2. Summarise Ideal Characteristics of Operational Amplifier.
3. Indicate the causes of slew rate.
4. Identify the features of successive approximation type ADC.
5. Compare Astable and Monostable Multivibrators.
6. Illustrate the working principle of Wien Bridge Oscillator using Op Amp.
7. Explain any two DC characteristics of an ideal op-amp.
8. Explain the vaious op amp frequency compensation technique.
9. Illustrate the operating principle of Single and Dual slope ADCs.
10. Identify the role of VCO in Phase Locked a Loop.
11. Indicate the Barkhausen Criterion for Oscillations.
12. Compare basic comparator & schmitt trigger.
13. Illustrate the basic IC Fabrication planar process.
14. Explain about the current mirror and widlar current source.
15. Identify the various basic building blocks of Op Amp.

Apply
1. An op-amp has a slew rate of 1V/ms, a unity gain frequency of 1MHz and output saturation levels of (+/-)12V .Design a non-inverting amplifier to provide maximum low frequency for a

bandwidth of 100 Hz. Compute the maximum peak amplitude of the input sinusoidal signal frequency 100kHz for an undistorted output.

2. Construct a Schmitt trigger for UTP=0.5V and LTP=-0.5V.
3. Predict the output voltage to be produced by a D/A converter whose output range is 0V to 10V and whose input binary number is a. 01[2 bit D/A] b. 0111 [4 bit D/A] c. 10111100 [8 bit D/A]
4. Find out step size and analog output for 4 bit R-2R ladder DAC when input is 0111 and 1111 (Assume Vref =+5V).
5. Design a monostable for a pulse width of 8ms by using IC555.
6. A 555 timer is configured to run an astable mode with RA =5kΩ , RB =5kΩ and C=0.01µF.Determine the frequency of the output and duty cycle.
7. Design an adder circuit using an op-amp to get the output expression as i) V0=-[0.1V1+V2+10V3] ii) V0=[0.2V1+V2+20V3] Where V1,V2,V3 are inputs.
8. Construct an astable multivibrator using op-amp to generate a frequency of 1KHz.(Assume R1=10K, C=0.05µF).
9. The basic steps of a 9 bit DAC is 10.3mv.000000000 represents 0 V find the output if input is 101101111.
10. Design a monostable multivibrator for a pulse width of 10ms by using IC555.
11. Predict the output voltage and gain of the amplifier circuit for a 0.3V, 3KHz sinusoidal input signal at non inverting terminal of Op Amp having input resistance and feedback resistance of 2K and100K respectively.
12. Design an amplifier circuit to provide a output voltage of -3.8V for an sinusoidal input signal of 0.2V assume resistance R1 = 2K.

Analyse

1. One differential amplifier has CMRR of 200 dB and another has CMRR of 50 dB. Which is preferable? Justify.
2. A PLL has a free running frequency of 500kHz and bandwidth of the low pass filter is 10kHz.Will the loop acquire lock for an input signal of 600kHz? Justify.
3. Differentiate openloop and closed loop opamp configuration.
4. Outline the functions of each pin in IC555.
5. Contrast Non Inverting Comparator and Inverting Zero Crossing Detector.
6. Differentiate Direct and Integrated Type ADCs.
7. Outline the BJT fabrication process.

Evaluate

1. An operational amplifier has a slew rate of 2V/µsec. If the peak output is 15V, Determine the power bandwidth.
2. Determine final output stage of DAC for the digital input of 0110.
3. An input of 3V is fed to the non-inverting terminal of an op-amp.The amplifier has a Ri of 10KΩ and Rf of 10KΩ .Determine the output voltage.

Create

1. Derive the gain of the inverting and non inverting amplifier.
2. Derive the frequecy fb of integrator and differentiator using Opamp.

15EC305 DATA STRUCTURES 2 0 2 3

Course Objectives

- To understand the concept of computer programming.
- To develop problem solving skills and troubleshooting techniques in electronics.
- To develop critical reasoning and problem solving abilities including the use of simulation software for designing and troubleshooting.

Programme Outcomes (POs)

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

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

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

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

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

Course Outcomes (COs)

1. Develop abstract data type models and design recursive algorithms.
2. Develop applications by using the concept of Stack, Queues and List.
3. Analyze various sorting and searching algorithms.
4. Apply the Binary Search tree, AVL search tree and Heap tree in writing C++ programs.
5. Apply minimum spanning tree and shortest path algorithms for real time problems.

Articulation Matrix

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

UNIT I **6 Hours**

INTRODUCTION

Pseudo code-Abstract Data types-Model for an ADT-ADT Implementations-Algorithm Efficiency-Designing Recursive Algorithms-Recursive Examples.

UNIT II **7 Hours**

LINEAR LIST: STACKS, QUEUES AND LISTS

Arrays : Basic Stack Operation-Stack ADT - Applications of Stack : Queues Operations- Queue ADT - Queue Applications-Linked List-Operations- Basic concepts of Circular and Doubly Linked List.

UNIT III **6 Hours**

SORTING AND SEARCHING

Sorting: Insertion Sort-Selection Sort-Bubble Sort - Quick sort-Heap sort-shell sort-External Sorts-Merge sort-Searching: Sequential search- Binary Search - Hashing-General Idea - Hash Function - Separate Chaining - Open Addressing - Linear Probing.

UNIT IV **5 Hours**

NON LINEAR LIST: TREES

Basic Tree concepts - Binary Trees-Tree Traversals -Expression Trees-Binary Search Trees - AVL Search Trees-Heap concepts-Implementation-Heap Applications: Priority Queue.

UNIT V **6 Hours**

GRAPHS

Definitions - Graph Representations - Adjacency matrix- Adjacency List-Traverse Graph: Depth first Traversal-Breadth first Traversal-Shortest Path Algorithms: Dijkstra's Algorithm. Minimum Spanning Tree: Prim's Algorithm- Kruskal's Algorithm.

FOR FURTHER READING

Analysis of various algorithm-Analysis of Stack, Array and Lists-Analysis of sorting algorithms-Analysis between binary and AVL trees-Applications of Dijkstra's Algorithm

1 **3 Hours**

EXPERIMENT 1

Program to perform various operations such as creation, insertion, deletion, search of node and display on singly linked list.

2 **2 Hours**

EXPERIMENT 2

Array Implementation of stack and queue with pre and post conditions.

3 **3 Hours**

EXPERIMENT 3

Linked List Implementation of stack and queue .

4 **3 Hours**

EXPERIMENT 4

Program to sort the elements in ascending order using selection sort and bubble sort

5 **2 Hours**

EXPERIMENT 5

Program to sort the elements in ascending order using shell sort and quick sort.

6 **2 Hours**

EXPERIMENT 6

Implementation of descending order to sort the elements using Heap sort.

7 **3 Hours**

EXPERIMENT 7

Implementation of Merge Sort.

8 **2 Hours**

EXPERIMENT 8

Develop a program to perform linear and binary search

9 **2 Hours**

EXPERIMENT 9

Implementation of binary tree traversals

10 **2 Hours**

EXPERIMENT 10

Write a program to perform infix into postfix expression, prefix to postfix expression

11 **2 Hours**

EXPERIMENT 11

Implementation of breadth first search and depth first search techniques.

12 **2 Hours**

EXPERIMENT 12

Design a postfix calculator (So 1 3 2 4 * - should calculate 1 - (3 * (2 4)).) using stack

13 **2 Hours**

EXPERIMENT 13

Design a Palindrome Checker using Dequeue

Total: 60 Hours

Reference(s)

1. F.RichardGilberg, A.Behrouz. Forouzan, Data Structures, A Pseudocode Approach with C, Thomson, 2007.
2. M. A. Weiss, Data Structures and Algorithm Analysis in C, Pearson Education, 2009.
3. Y.Langsam, M. J.Augenstein and A. M.Tenenbaum, Data Structures using C, Pearson Education, 2004.
4. A. M.AhoHopcroft and J.D. Ullman, Data Structures and Algorithms, Pearson education, 2000.

Assessment Pattern

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

Assessment Questions

Remember

1. What is a data structure?
2. What is a non-linear data structure?
3. What is a linear data structure?

4. List out the areas in which data structures are applied extensively.
5. What is tree and List out few of the applications of tree data-structure?

Understand

1. Write a class definition that could be used to define a node in a doubly linked list. Include only the instance variables, not the methods. Also write one sentence to describe a situation when a doubly linked list is appropriate.
2. Sort the given values using Quick Sort?
3. Describe the time complexity of sorting and searching algorithms.
4. Classify the Hashing Functions based on the methods by which the key value is found.
5. What is the suitable efficient data structure for constructing a tree?
6. What is the condition for balancing to be done in an AVL tree?
7. Enumerate Binary Search with suitable example and algorithm.
8. How do you traverse a given tree using Inorder, Preorder and Postorder traversals?
9. How many null branches are there in a binary tree with 20 nodes?

Apply

1. Convert the expression (a+b)*c/d-e into infix, prefix and postfix notations. Demonstrate Djikstra's algorithm to find the shortest distance in a weighted graph.
2. Differentiate linear and nonlinear data structure.
3. Contrast ADT implementation of array and linked list.
4. Compare internal and external sorting.
5. Apply sorting algorithms to arrange the playing cards in descending order
6. Apply binary searching algorithm to search a particular file from various folders
7. Apply prims algorithm to access a file with minimum distance
8. Apply Kruskal algorithm to access a file with minimum distance
9. Apply BFS and DFS for backtracking of a File or folder
10. Apply and analyze the stack, queue to store and retrieve data from the memory

Analyse

1. Differentiate between binary tree and binary search tree.
2. Compare linear and binary search.
3. Distinguish DFS and BFS.
4. Analyze the time complexity of Stack using ADT.
5. Analyze the time complexity of Queue using ADT.
6. Analyze the time complexity of BFS and DFS.
7. Analyze the time complexity of Binary Tree.
8. Evaluate the time Complexity of AVL tree

Evaluate

1. Evaluate the best case and worst case complexity for searching algorithms.
2. Can stack be used to perform queue operations? Judge.
3. Analyze the Time Compexity of List using ADT.

Create

1. Develop an application using a stack /Queue /List /Tree that reflects on real world problem.
2. From various algorithms select a algorithm to create an application to store, retrieve, sort and search with minimum time complexity using ADT

15EC306 DIGITAL ELECTRONICS AND VHDL 3 0 0 3

Course Objectives

- To gain knowledge on the fundamentals of digital logic
- To understand the various number systems and codes

- To study the design and issues related combinational circuits, sequential circuits and VHDL programming

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Implement the logic circuit for reduced boolean expressions obtained using k-map and Quine McCluskey methods
2. Design combinational logic circuits using appropriate logic gates.
3. Analyze the operation of Latches and Flipflops in digital circuits
4. Design synchronous and asynchronous sequential logic circuits
5. Analyze the logic families and mapping of data path elements using VHDL

Articulation Matrix

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

UNIT I **8 Hours**

BOOLEAN THEOREMS AND LOGIC REDUCTION

Boolean theorems- DeMorgans theorems-Implementing circuits from Boolean expressions-Logic gates-Universality of NAND and NOR gates-Inhibit circuits and Pulsed operation of logic gates- Sum of Product- Product of Sum-Standard representation of logic functions-Minterm to Maxterm conversion-Simplification of logic functions using K-map-Five variable K Map- Quine McCluskey Method

UNIT II **11 Hours**

COMBINATIONAL LOGIC DESIGN

1- Bit Adder-1 Bit Subtractor-RCA- CLA -Adder/Subtractor -Decoders - Encoders- Multiplexers - Demultiplexers - Implementation of Combinational circuits using multiplexers - Computer codes - BCD, Gray code, Excess-3 code, Parity code-Code conversion - Error detection and Correction codes - Hamming codes- Parity Generator and Checker.

UNIT III **8 Hours**

LATCHES AND FLIPFLOPS

NAND gate latch- Nor gate latch- Digital pulses-Clocked signals and Clocked Flip-Flops-Asynchronous Inputs-Flip-Flop Timing Considerations-Potential Timing problem in FF circuits-Master/Slave Flip-Flop-Flip-Flop Applications-Flip flop synchronization-Detecting an Input Sequence- Data Storage and Transfer

UNIT IV **11 Hours**

SEQUENTIAL CIRCUITS AND REGISTERS

General model of sequential circuits- Mealy/Moore models -Excitation table- State table- State diagram - Design of synchronous sequential circuits- Synchronous up/down counters- Modulus counters - Shift registers - Ring counter - Johnson counter - Sequence detector-Asynchronous sequential logic-Asynchronous counter- Hazards in combinational circuits- Hazard free realization

UNIT V **7 Hours**

LOGIC FAMILIES AND VHDL

Characteristics of ICs - TTL-CMOS Logic Family - Introduction about VHDL- Operators- Dataflow Modeling- Structural Modeling- Behavioral Modeling - IF Statements- CASE Statements- Logic Circuit Design using VHDL

FOR FURTHER READING

Numerical Representation- Number system conversion- Magnitude comparator-Universal andDynamic shift register-VHDL program for comparators

Total: 45 Hours

Reference(s)

1. Ronald J Tocci, Neal S Widmer,Gregory L Moss Digital Systems: Principles and Applications, 10th edition, Person , 2009.
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015
3. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011
4. J.Bhaskar, A VHDL Primer, Prentice Hall, 1998
5. A.Anand Kumar, Fundamentals of Digital Electronics, 2nd Edition PHI Learning Private Limited, 2013
6. D. Donald Givone, Digital principles and design, Tata McGraw Hill, 2008

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		2								8								8							18
2						2			4					8							8				22
3					2	8				8															18
4											8		8								8				24
5		2			8					8															18
																								Total	100

Assessment Questions

Remember

1. Diffrentiate weighted codes and non-weighted codes.
2. Define Duality Property.
3. What are 'minterms' and 'maxterms'?
4. List the characteristics of digital logic family.
5. Draw the circuit diagram of dynamic MOS Nand gate.
6. What do you mean by encoder?
7. What are the three possible output states of a tri-state IC?
8. Draw the structure of NMOS devices.
9. Mention the various operators used in VHDL coding.
10. Define test bench.

Understand

1. Find the Octal equivalent of the decimal number 25.
2. Express x'+yz as the sum of minterms.
3. Find the value of X = A B C (A+D) if A=0; B=0; C=1 and D=1.
4. How will you use a 4 input NAND gate as a 2 input NAND gate?
5. List the truth table of the function: F = x y + x y' + y 'z.
6. Design the combinational circuit with 3 inputs and 1 output. The output is 1 when the binary value of the inputs is less than 3.The output is 0 otherwise.
7. Draw the state diagram of 'T' FF, 'D' FF.
8. Generate the even parity hamming codes for the following binary data 1101, 1001.
9. Generate the VHDL code for full adder.
10. What do you meant by concurrent constructs?

Apply

1. Why are NAND and NOR gates are known as Universal gates?
2. Simplify using K-map to obtain a minimum POS expression: (A' + B'+C+D) (A+B'+C+D) (A+B+C+D') (A+B+C'+D') (A'+B+C'+D') (A+B+C'+D).
3. Find the Minterm expansion of f(a,b,c,d) = a'(b'+d) + acd'.
4. Using a single 7483, Draw the logic diagram of a 4 bit adder/subtractor.
5. Implement the switching function F= Σm (0,1,3,4,7) using a 4 input MUX.
6. Design a switching circuit that converts a 4 bit binary code into a 4 bit Gray code using ROM array.
7. Design a synchronous counter with states 0,1, 2,3,0,1 .... Using JK FF.
8. Implement an 8-bit ripple carry adder using VHDL entity.
9. Design a program for a 16X1 multiplexer having time to input as 1ns.
10. Implement an two input ECL OR/NOR gate circuit when both input are at logic 0.

Analyse

1. Design an entity and architecture statements for a 8-bit comparator.
2. Implement the switching functions: Z1 = ab'd'e + a'b'c'e' + bc + de, Z2 = a'c'e, Z3 = bc +de+c'd'e'+bd and Z4 = a'c'e +ce Using a 5*8*4 PLA.
3. Design a synchronous counter with states 0,1, 2,3,0,1 .... Using JK FF.
4. Realize a BCD to Excess 3 code conversion circuit starting from its truth table
5. Show that if all the gates in a two – level AND-OR gate networks are replaced by NAND gates the output function does not change.
6. What are the steps for the analysis of asynchronous sequential circuit?

Evaluate

1. Why are MOS ICs especially sensitive to static charges?
2. Using SR flip flops, design a parallel counter which counts in the sequence 000,111,101,110,001,010,000.............

3. Construct the state diagram and primitive flow table for an asynchronous network that has two inputs and output. The input sequence X1X2 = 00, 01, 11 causes the output to become 1.The next input change then causes the output to return to 0.No other inputs will produce a 1 output.
4. Develop the state diagram and primitive flow table for a logic system that has 2 inputs x and y and an outputz.And reduce primitive flow table. The behavior of the circuit is stated as follows. Initially x=y=0 Whenever x=1 and y = 0 then z=1, whenever x = 0 and y = 1 then z = 0.When x =y = 0 or x = y = 1 no change in z it remains in the previous state. The logic system has edgetriggered inputs with out having a clock 1 .the logic system changes state on the rising edges of the 2 inputs. Static input values are not to have any effect in changing the Z output.

Create

1. Develop a sequence detector using D-FFs which generates an output z=1 whenever the string is 0110 and generates a 0 at all other times where overlapping sequence are detected.
2. Design an VHDL code to design traffic light controller.

15EC307 MICROELECTRONICS AND INTEGRATED CIRCUITS LABORATORY — 0 0 2 1

Course Objectives

- To gain knowledge on large signal power amplifiers,feedback amplifiers and oscillators.
- To study the characteristics of operational amplifier and special function ICs.
- To gain knowledge on different types of Multivibrators.

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.

PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Design and analyse the performance of Power amplifiers.
2. Design an Oscillator for the given specifications.
3. Analyse the factors which effect oscillation and amplification in circuits.
4. Design and analyze an amplifiers, filters and oscillator using OP AMP.
5. Design and Analyze an amplifier and oscillator using Circuit Simulator.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Effect of hfe of transistors in Voltage divider bias.

2 **2 Hours**

EXPERIMENT 2

Design of Darlington pair.

3 **2 Hours**

EXPERIMENT 3

Differential Amplifiers.

4 **2 Hours**

EXPERIMENT 4

Frequency Response of Class-B Complementary symmetry Power Amplifier.

5 **2 Hours**

EXPERIMENT 5

Feedback amplifier circuits-current series and voltage shunt.

6 **2 Hours**

EXPERIMENT 6

Transistor based design of Hartley/Colpitts Oscillator circuit.

7 **2 Hours**

EXPERIMENT 7

Applications of Linear Op-Amp circuits- Inverting and Non inverting Amplifiers, Voltage Follower, Differentiator, Integrator,summer.

8 **2 Hours**

EXPERIMENT 8

Comparator circuits-Zero crossing detector and Schmitt trigger.

9 **3 Hours**

EXPERIMENT 9

Butterworth Active filters using Op-Amps - second order LPF/HPF/BPF.

10 **2 Hours**

EXPERIMENT 10

Monostable Multivibrator using Op-Amp.

11 **3 Hours**

EXPERIMENT 11

Oscillators using Op-Amps-RC-phase shift oscillator/Wien bridge oscillator.

12 **3 Hours**

EXPERIMENT 12

Characteristics of PLL using IC565.

13 **3 Hours**

EXPERIMENT 13

Using Circuit Simulator

1.Design a emitter follower circuit with Vcc=10V,I=100mA, and RL=100 ohm. If the output voltage is 8V peak to peak sinusoid find the power delivered to the load.
2.Design a Class B Push Pull amplifier with Vcc = 50V, total power dissipation of 40 W find the conversion efficiency.
3.Design an RC phase shift oscillator for a frequency of 2 KHz.
4.Multivibrator Circuit using transistors
Astable Multivibrator
Monostable Multivibrator
5.Design window detector using suitable components.

Total: 30 Hours

Reference(s)

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory an Applications ,5th Edition, Oxford University, 2006.
2. Jacob Millman, C. Halkias and Satyabrata Jit, Electronic Devices and Circuits, 3rd Edition, Tata McGraw-Hill, 2011
3. Jacob Millman, C. Halkias and Satyabrata Jit "Electronic Devices and Circuits", 3rd Edition, Tata McGraw-Hill, 2011

15EC308 DIGITAL ELECTRONICS AND VHDL LABORATORY

0 0 2 1

Course Objectives

- To understand the simplified expression using logic gates.
- To gain knowledge on various types of combinational, sequential and digital logic circuits.
- To understand the importance and need for verification, testing of digital logic and design for testability.
- To remember various synchronous and asynchronous sequential circuits.

Programme Outcomes (POs)
a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. PSO1: Able to design new concepts in the domains of Microelectronics and Communication Engineering.
Course Outcomes (COs)

1. Implementation of boolean expressions using universal gates and VHDL.
2. Design various types of combinational circuits using logic gates and VHDL.
3. Conversion of Flip-flops in the design of sequential circuit using logic gates and VHDL.
4. Design different types of shift registers for data transfer using flip-flops.
5. Design up/down counters to count the sequence of input pulses using logic gates.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1
Implementation of Boolean logic functions using universal gates and VHDL.

2 **2 Hours**

EXPERIMENT 2
Design and implementation of code converters using logic gates and VHDL.
(i) BCD to excess-3 code and vice versa
(ii) Binary to gray and vice-versa

3 **2 Hours**

EXPERIMENT 3
Implementation of arithmetic operations
a)Binary Adder/ subtractor using logic gates and VHDL.
b) BCD adder using logic gates.

4 **2 Hours**

EXPERIMENT 4

Design and implementation of 2 Bit Magnitude Comparator using logic gates and VHDL.

5 **2 Hours**

EXPERIMENT 5

Design and implementation of odd/even parity generator and checker using logic gates and VHDL.

6 **2 Hours**

EXPERIMENT 6

Design and implementation of encoder and decoder using logic gates and VHDL.

7 **3 Hours**

EXPERIMENT 7

Design and implementation of priority encoder using logic gates and VHDL.

8 **3 Hours**

EXPERIMENT 8

Design and implementation of multiplexer and demultiplexer logic gates and VHDL.

9 **3 Hours**

EXPERIMENT 9

Design and implementation of Standard Boolean function with data selector and data decoder using logic gates and VHDL.

10 **3 Hours**

EXPERIMENT 10

Conversion of flip-flops using logic gates and VHDL.

11 **3 Hours**

EXPERIMENT 11

Design and Implementation of Shift registers for data transfer
(i) SISO
(ii) SIPO
(iii) PISO
(iv) PIPO
using logic gates.

12 **3 Hours**

EXPERIMENT 12

Design and implementation of shift register counters to count a sequence of input pulse using logic gates.

Total: 30 Hours

Reference(s)

1. Ronald J Tocci, Neal S Widmer,Gregory L Moss Digital Systems: Principles and Applications, 10th edition, Person , 2009
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.

3. Tokheim Digital Electronics: Principles and Applications, 7th edition Tata McGraw-Hill, 2010.
4. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011
5. A.Anand Kumar, Fundamentals of Digital Electronics, 2nd Edition PHI Learning Private Limited, 2013
6. J.Bhaskar, A VHDL Primer, Prentice Hall, 1998.

15EC309 MINI PROJECT I 0 0 2 1

Course Objectives

- Speculate the problem identifying ability
- Improve the analyzing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

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

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

15GE310 LIFE SKILLS: BUSINESS ENGLISH 0 0 2 0

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

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

Articulation Matrix

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

1 **15 Hours**

UNIT I LISTENING AND READING

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

2 **15 Hours**

UNIT II WRITING AND SPEAKING

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

Total: 30 Hours

Reference(s)

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

15MA402 PROBABILITY AND STATISTICS 2 2 0 3

Course Objectives

- By enrolling and studying this course the students will be able to understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables.
- Summarize and apply the methodologies for the data analysis using statistical notions.
- 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. Apply the concepts of probability distributions in an appropriate place of science and Engineering.
3. Calculate the relationship of two dimensional random variables using correlation techniques and to study the properties of two dimensional random variables.

4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
5. Design an experiment for an appropriate situation using ANOVA technique.

Articulation Matrix

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

UNIT I **6 Hours**

PROBABILITY AND RANDOM VARIABLES

Probability - Axioms of Probability - Conditional Probability - Total Probability - Baye's Theorem - Random Variables- Probability mass function - Probability density function- Properties- Moment Generating function

UNIT II **7 Hours**

STANDARD DISTRIBUTIONS

Moment generating functions of probability distributions- Concepts and applications of standard Probability distributions: Binomial- Poisson- Geometric- Uniform - Exponential and Normal Distributions.

UNIT III **5 Hours**

TWO DIMENSIONAL RANDOM VARIABLES

Joint Distribution - Discrete and continuous distributions - Marginal and Conditional Distributions - Co variance - Correlation.

UNIT IV **6 Hours**

TESTING OF HYPOTHESIS

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

UNIT V **6 Hours**

DESIGN OF EXPERIMENTS

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

SELF STUDY

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

Total: 60 Hours

Reference(s)

1. 1.R.A Johnson, Miller & Freund's Probability and Statistics for Engineers, Seventh Edition, Pearson Education, Delhi, 2009.

2. 2.S.C Gupta and J.N. Kapur , Fundamentals of Mathematical Statistics, Sultan Chand and Co., New Delhi, 2002.
3. 3.G. S. S. Bhishma Rao, Probability and Statistics, Fifth Edition, 2011.
4. 4.William W. Hines, Douglas C. Montgomery, David M. Goldman, Probability and Statistics in Engineering, Fourth Edition, 2008.
5. 5.Ronald.E.Walpole, Raymond.H.Myers, Sharon.L.Myers, Keying Ye, Probability and Statistics for Engineers and Scientists, Eighth Edition, Pearson Prentice Hall, 2007.
6. R.A Johnson, Miller & Freund's Probability and Statistics for Engineers, Seventh Edition, Pearson Education, Delhi, 2009

Assessment Pattern

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

Assessment Questions
Remember

1. Define Random Variable.
2. State Bayes's theorem
3. State memory less property for Exponential Distribution.
4. Define mean, variance of rectangular distribution
5. State the properties of coefficient of correlation.
6. Define joint probability mass function.
7. State the region of acceptance.
8. List the types of errors in the hypothesis testing.
9. State the difference between CRD and RBD.
10. List the uses of Latin Square Design.

Understand

1. If A and B are events in S such that $P(A \cap B)=1/4$, $P(\overline{A})=2/3$ and $P(A \cup B)=3/4$. Represent $P(\overline{A}/B)$.
2. For f(x,y) = kxy ; 0< x < 1 ; 1 < y < 2 identify the value of k.
3. If X is a uniform random variable in [-2, 2], identify the probability density function of X and var(X).
4. Identify the moment generating function of the binomial distribution and hence find its mean and variance.
5. The joint probability density function of the random variable (X,Y) is given by $f(x,y) = K\,xy\,e^{-(x^2+y^2)}$,x> 0, y> 0. Identify the value of K and prove also that X and Y are independent.
6. The joint probability function (X , Y) is given by P(x, y) = k(2x + 3y), x = 0,1,2; Y = 1,2,3. Explain the marginal distribution.

7. Compare t test and F test.
8. List the properties and the advantages of $\chi^2 - test$.
9. Explain the principles of experimental design.
10. Compare RBD and CRD.

Apply

1. If A is any event in S, then show that $P(\overline{A}) = 1 - P(A)$.
2. In a class of 100 students 75 are boys and 25 are girls. The chance that a boy gets a first class is 0.25 and the probability that a girl gets first class is 0.21.Find the probability that a student selected at random gets a first class.
3. A car rental agency has 18 compact cars and 12 intermediate-size cars. If four of the cars are Randomly selected for a safety check, predict the Probability of getting two of each kind?
4. In a newly constructed township, 2000 electric lamps are installed with an average life of 1000 burning hours and standard deviation of 200 hours. Assuming the life of the lamps follows normal distribution, find the number of lamps expected to fail during the first 700 hours .
5. If a random variable has the binomial distribution with n = 40 and p = 0.40, use the normal approximation to compute the probabilities that it will take on
   a) the value 22
   b) a value less than 8
6. Buses arrives at a specified stop at 15-min interval starting at 7 am. that is ,they arrive at 7, 7.15, 7.30, 7.45 and so on. If a passenger arrives at a stop at a random time that is uniformly distributed between 7 and 7;30, find the probability that he waits for i) less than 5 minutes for a bus ii) more than 10 minutes for a bus.
7. A certain machine makes electrical resistors having mean resistance of 40 ohms and standard deviation of 20 ohms. Assuming that the resistance follows a normal distribution and can be measured to any degree of accuracy
   i) Find the percentage of resistors have resistances that exceed 43 ohms .
   ii) Find the percentage of resistors will have resistances that exceed 43 ohms to the nearest ohm.
8. The joint probability function (X, Y) is given by P(x,y) = k(2x+3y), x= 0, 1, 2; y = 1, 2, 3. Find the marginal distributions.
9. The mean life time of a sample of 100 light tubes produced by a company is found to be 1580 hours with standard deviation of 90 hours. Compute the hypothesis that the mean lifetime Of the tubes produced by the company is 1600 hours.
10. 4 Coins were tossed 160 times and the following results were obtained

No. of heads :	0	1	2	3	4
Observed frequencies :	17	52	54	31	6

Under the assumption that the coins are balanced, find the expected of getting 0, 1, 2, 3, 4 heads and test the goodness of fit.

Analyze / Evaluate

1. A given lot of IC-chips contains 2% defective chips. Each is tested before delivery. The tester itself is not totally reliable. Probability of tester says the chip is good when it is really good is 0.95 and the probability of tester says chip is effective when it is actually defective is 0.94. If a tested device is indicated to be defective, Determine the probability that it is actually defective .
2. In a city 60% people read newspaper A, 40% read newspaper B, 30% read newspaper C, 20% read newspapers A & B, 30% read newspapers A & C, 10% read newspapers B & C, 15% read newspapers A, B & C. Evaluate the percentage of the people who do not read newspaper at all

3. A passenger arrives at a bus stop at 10.00A.M, knowing that the bus will arrive at sometime uniformly distributed between 10.00A.M and 10.30A.M. Resolve the probability that he will have to wait longer than 10 minutes ? If at 10.15A.M the bus has not yet arrived, Determine the probability that he will have to wait atleast 10 additional minutes ?
4. In a certain factory turning razor blades, there is a small chance of 1/500 for any blade to be defective. The blades are in packets of 10. Identify Poisson distribution to compute the approximate number of packets containing i) 1 defective ii) 2 defective blades respectively in a consignment of 1000 packets.
5. If X and Y are two R.V's having joint density function

$$f(x,y) = \begin{cases} \frac{1}{8}(6-x-y); 0 < x < 2, 2 < y < 4 \\ 0 : otherwise \end{cases}.$$

Determine $i) P(X < 1 \cap Y < 3), ii) P(X + Y < 3) and\ iii)\ P(X < 1 / Y < 3)$.

6. Given is the joint distribution of X and Y :

	0	1	2
0	0.02	0.08	0.10
1	0.05	0.20	0.25
2	0.03	0.12	0.15

Identify i) Marginal distribution ii) The conditional distribution of X given Y= 0.

7. A car hire firm has 2 cars which it hires out daily the number of demands for a car on each day is distributed with mean 1.5. Obtain the proportion of days on which i) no demand ii) demand is refused.

8. A farmer applied 3 types of fertilizers on 4 separate plots. The figure on yield per acre are tabulated below:

Fertilizers	Yield			
	A	B	C	D
Nitrogen	6	4	8	6
Potash	7	6	6	9
Phosphates	8	5	10	9
Total	21	15	24	24

Find out if the plots are materially different in fertility, as also, if the three fertilizers make any material difference yields.

9. A company appoints 4 salesmen A, B, C and D and observes their sales in 3 seasons: Summer, Winter and Monsoon. The figures (in Lakhs of Rs) are given in the following table.

	Salesmen			
Season .	A	B	C	D
Summer	45	40	38	37
Winter	43	41	45	38
Monsoon	39	39	41	41

Carry out an analysis of variance.

10. In a Latin square experiment given below are the yields in quintals per acre on the paddy crop carried out for testing the effect of four fertilizers A, B, C and D. Analyse the data for variances.

A18	C21	D25	B11
D22	B12	A15	C19
B15	A20	C23	D24
C22	D21	B10	A17

15EC402 SIGNALS AND SYSTEMS 3 2 0 4

Course Objectives

- To Understand the various signals and systems
- To Represent the signals and systems using different transforms
- To Understand the concept of sampling

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.

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Classify and analyze continuous time and discrete time signals and systems
2. Apply the Fourier Transform for analysis of Discrete Time Signals
3. Compute DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithms
4. Analyze the Linear Time Invariant - Continuous Time systems in time and frequency domain
5. Analyze the Linear Time Invariant - Discrete Time systems in time and frequency domain

Articulation Matrix

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

UNIT I **9 Hours**

CLASSIFICATION OF SIGNALS AND SYSTEMS

Classification of Signals: Continuous and discrete time signals-Standard Signals- Basic Operations on Signals- Basic properties of systems: Linearity, Causality, time invariance, stability and Dynamic Properties

UNIT II **9 Hours**

ANALYSIS OF DISCRETE TIME SIGNALS

Sampling: Representation of continuous time signals by its sample - Sampling theorem - Reconstruction of a Signal from its samples, aliasing - Discrete Time Fourier Transform (DTFT)-Properties - Inverse DTFT.

UNIT III **9 Hours**

DISCRETE FOURIER TRANSFORM AND FAST FOURIER TRANSFORM

Discrete Fourier Transform -Properties - Inverse DFT- Fast Fourier Transform - Radix-2 FFT - Decimation-in-time and Decimation-in-frequency algorithms.

UNIT IV **9 Hours**

LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS

LTI CT System: Convolution integral - Differential Equation-Block diagram representation-Analysis of CT systems: Fourier and Laplace transforms-Interconnection of LTI systems.

UNIT V **9 Hours**

LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

LTI DT System: Linear and Circular Convolutions- Difference Equations-Block diagram representation - Analysis of DT Systems: Fourier and Z Transform.

FOR FURTHER READING

Signal Transform in Communication and Signal Processing- Convolution in Communication System - Correlation Analysis in Radar Applications - Spectral Analysis in communication Systems- Power Spectrum estimation.

Total: 75 Hours

Reference(s)

1. V. Alan.Oppenheim, Alan S.Willsky with S.HamidNawab, Signals & Systems, 2nd Edition, Pearson Education, Limited, 2013.
2. M J Roberts, Signals and Systems Analysis using Transform method and MATLAB, McGraw-Hill Higher Education, 2012.
3. H P Hsu, Signals and systems, Schaum's outlines, 2nd Edition,Tata McGraw-Hill, 2010
4. Simon Haykin and Barry Van Veen, Signals and Systems, 2nd Edition, John Wiley, 2008.
5. Keng,Lable bick,"CMOS Digital Integrated Circuits", Tata McGraw Hill, 2014
6. Jan M Rabaey, Digital Integrated Circuits- A Design, Prenitice Hall, Dec 2015

Assessment Pattern

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

Assessment Questions

Remember

1. Define Signals and Systems.
2. Mention the properties of signals and systems.
3. Define Sampling Theorem

4. List the properties of DTFT
5. What is the purpose of FFT?
6. Enlist the properties of DT Fourier series and Fourier Transform.
7. State the BIBO Criterion for stability.
8. What are the blocks used for block diagram representation?
9. Write the difference equation for Discrete time system.
10. Define frequency response of the DT system.

Understand

1. Graph g(t)=4sinc(5(t-3)).
2. What is the periodicity of x(t)=exp(j200πt+30)?
3. Determine the Nyquist sampling rate and Nyquist sampling intervals for the signal x(t)= sinc(100πt)sinc(200πt).
4. How to overcome aliasing effect?
5. What is the usage of zero padding?
6. What is the relationship between DTFT and DFT ?
7. Determine the transfer function for the system described by the difference equation y(n)- y(n-1) = x(n)- x(n-2).
8. What is zero input Response?
9. State the significance of block diagram representation.
10. Graphically explain the distributive property of convolution integral.

Apply

1. For the systems described by the equations below determine whether it is time invariant or time varying system. y(t)=f(t-2), y(t)=f(-t), y(t)=f(at), y(t)=t.f(t-2).
2. Determine whether the following sum of periodic signals is periodic or not. (i) x(t)=2cos(10t+1) - sin(4t-1) (ii) x(n)=cos(2n)+cos(p/4 n)
3. Graphically represent a sampled signal from a continuous time signal.
4. Prove convolution property of DTFT.
5. Find the DFT of a sequence x(n)={1,3,5,7,2,4,6,8}using DIT & DIF algorithm.
6. State and prove properties of Discrete Fourier transform.
7. Graphically explain the convolution property for continuous time signal.
8. An input x(t)=exp(-2t)u(t)+δ(t-6) is applied to an LTI system with impulse response h(t)=u(t). Find the output of the LTI system.
9. What is the condition for causality if H(z) is given.
10. Find the direct form I and direct form II realization of a second order discrete time system represented by the difference equation.

Analyse

1. Compare deterministic and random signals.
2. The signal x(t) =10cos(10pt) is sampled at a rate of 10 samples per second. Plot the a). Spectrum of input signal b). Spectrum of sampled signal c). Spectrum of reconstructed signal.
3. Compare the complexities involved to perform FFT and DFT.
4. Determine whether the given system is h(t)=e^-|t |causal or not.
5. Given x(n)=α^n.u(n),h(n)=β^n.u(n).Find y(n) of LTI system

Evaluate

1. Sketch the following signals. (a) r(-2)+ r(t-2) -4 r(t+3) (b) 3u(- t - 4)
2. Consider the analog signal x(t)=3cos(100*pi*t). Suppose that the signal is sampled at the rate Fs = 200 Hz. What is the discrete-time Signal obtained after sampling?

3. Determine IDFT for the sequence X(k) = {20, -5.828-j2.414, 0, -0.172-j0.414, 0, -0.172+j 0.414, 0, -5.828+j 2.414} using DIT-FFT Algorithm.
4. Determine the impulse response of the system described by the following Linear differential equation: y(t)+1/4 dy(t)/dt=x(t)+1/2dx(t)/dt
5. Given x(n)=(1/4)^n.u(n) and y(n)-3/4y(n-1)+(1/8)y(n-2)=2x(n).Find y(n).

Create

1. In communication systems, generate PAM signals using sampling theorem.
2. Using Discrete Fourier Transform, design a digital filter.

15EC403 ANALOG COMMUNICATION 3 2 0 4

Course Objectives

- To provide an introduction on different analog modulation and demodulation systems.
- To provide an analysis in noise performance of various receiver.
- To learn Pulse analog modulation

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.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Derive and analyze the mathematical model for generation and detection of different AM systems based on time domain representation and its spectrum
2. Describe the process involved in Frequency Modulation and phase modulation systems and analyze with its mathematical model
3. Analyze and characterize the different types of noise in communication systems
4. Compare the noise performance of AM and FM receivers
5. Apply the concepts of sampling process and determine the characteristics of Pulse Analog Modulation schemes.

Articulation Matrix

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

UNIT I **9 Hours**

AMPLITUDE MODULATION SYSTEMS

Need for modulation- Classifications of modulation techniques-Generation and detection: AM, DSB-SC, SSB-SC, VSB-Comparison of Amplitude modulation systems- AM transmitters-AM receivers.

UNIT II **9 Hours**

ANGLE MODULATION SYSTEMS

Frequency modulation: Narrowband and wideband FM- Phase Modulation- Generation of FM signal: Direct FM, indirect FM- Demodulation of FM signals -FM stereo multiplexing- FM transmitters- FM receivers.

UNIT III **9 Hours**

NOISES IN COMMUNICATION SYSTEMS

Random variable-Random process- strict sense stationary-wide sense stationary- Ergodic process-Gaussian process- Wiener-Khinchin theorem-Noise calculations - noise figure-noise temperature-Noise equivalent Bandwidth, Narrowband noise, Representation of Narrowband noise in terms of envelope and phase components, Sine wave plus Narrowband Noise

UNIT IV **9 Hours**

NOISE PERFORMANCE OF AM AND FM RECEIVERS

Noise in AM receivers- Noise in DSB-SC receiver- Noise in SSB receiver- Noise in FM receivers-Capture and threshold effect- Pre-emphasis and de-emphasis in FM-Comparison of noise performance of AM and FM systems.

UNIT V **9 Hours**

PULSE ANALOG MODULATION

Sampling of Band limited Low pass signals, ideal and practical sampling- Anti aliasing and reconstruction filters- PAM: generation and detection-Time division Multiplexing- Pulse Time Modulation systems: generation -detection.

SELF STUDY TOPICS

Working principle of MODEM, AM /FM broadcasting, Design of AM and FM radio, Television Receivers.

Total: 75 Hours

Reference(s)

1. G.Kennedy and B.Davis,Electronic Communication Systems, fourth Edition , Tata McGraw-Hill -2008.
2. Simon Haykin, Communication Systems, John Wiley, 2001.

3. P.Michael Fitz, Fundamentals of Communication System, Tata McGraw-Hill -2008.
4. P.Rama Krishna rao, Analog Communication, Tata McGraw-Hill -2011
5. Taub and Schilling, Principles of communication systems, Tata McGraw-Hill, 1995.
6. Bruce Carlson et al, Communication systems, McGraw-Hill,2002.

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2				6					6				6				4						26
2		2					6				6				4				6						24
3	2	2				4				4				2											14
4	2	4				2	4				4														16
5	2	2				2	4			6				4											20
																								Total	100

Assessment Questions
Remember

1. State the need for modulation.
2. What is shot noise?
3. State the property of White Gaussian Noise.
4. Define modulation.
5. What are the types of analog modulation?
6. Define depth of modulation.
7. What are the degrees of modulation?
8. What are the types of AM modulators?
9. Define demodulation.
10. What are the types of AM detectors?
11. Draw the block diagram of coherent detector.
12. Define super heterodyne principle.
13. . Define frequency modulation.
14. Define modulation index of frequency modulation.
15. What are the types of Frequency Modulation?
16. What is the basic difference between an AM signal and a narrowband FM signal?
17. What are the two methods of producing an FM wave?
18. Define frequency Deviation.
19. What are the disadvantages of FM system?
20. Define sampling theorem.
21. List different types of sampling.
22. What is PAM?
23. Mention the types of PTM.

Understand

1. Differentiate AM and FM.
2. How much power is saved in DSBSC-AM and SSB-AM?
3. Define modulation index and frequency deviation of FM .

4. What is single tone and multi tone modulation?
5. Compare AM with DSB-SC and SSB-SC.
6. Compare WBFM and NBFM.
7. List the properties of the Bessel function.
8. When do you say that two signals x (t) and y(t) are orthogonal and orthonormal?
9. What is modulation index? What happens if it is greater than unity?
10. What are the steps taken in commercial TV broadcasting to ensure that the distortion arising in the detected video signal owing the use of an envelope detector is within the tolerable limits?
11. How is a phase-locked loop (PLL) useful in detecting the FM signal?
12. Why is a limiter stage used in the super heterodyne FM broadcast receiver?
13. Explain the principles of the working of the limiter. Sketch the transfer function of a hard limiter.

Apply

1. A 10 MHz carrier is modulated with 5 KHz sine wave. What is the bandwidth of transmitted AM signal?
2. What is the bandwidth requirement to transmit an FM signal with a modulating frequency of 10KHz and a carrier deviation of 30 KHz?
3. Calculate the SNR at receiver output assuming that the bandwidth is 10 MHz.
4. Calculate the capacity of a channel, which has a bandwidth of 3.4 kHz for a signal to noise ratio of 30dB.
5. The antenna current of an AM transmitter is 8A when only carrier is sent. It increases to 8.93A when the carrier is modulated by a single sine wave. Find the percentage of modulation.
6. A transmitter supplies 8 KW to the antenna when modulated. Determine the total power radiated when modulated to 30%.
7. A carrier signal is sinusoidally modulated to a depth of m=0.8. What percentage of the total power of the modulated signal is in the two side bands?
8. A superheterodyne receiver has an IF of 460 kHz. Its RF amplifier is tuned to an incoming signal of 700 kHz carrier frequency. If at this frequency the tuned circuit of the RF amplifier has a Q of 60, determine the image frequency rejection in rejection in db.

Analyze

1. The intermediate frequency of a super heterodyne receiver is 450 kHz. If it is tuned to 1200 kHz, what would be the image frequency?
2. For a FM transmission with a frequency deviation of 20 KHz. Determine the percent modulation for commercial FM station.
3. How FM wave can be converted to PM wave?
4. How PM wave can be converted to FM wave?
5. In the filter method of generation of an SSB-SC signal, why do we have to use initially a low frequency carrier?
6. A double conversion receiver is tuned to an incoming signal of 25 MHz at which frequency its tank circuit has a Q of 65,The receiver is using a first IF of 1.5MHz and a second IF of150kHz.Calculate (in decibels) the image frequency rejection. Make reasonable assumptions, if necessary.
7. An AM transmitter is used to send a message signal with x2 =0.5 and a bandwidth of 5 MHz over a channel which introduces additive white noise with a power spectral density of 10-12 W/Hz. The modulation index is equal to 1.If the channel introduces a loss of 100 dB, and if the average transmitted power is 200W. Find the destination signal–to– noise ratio.

Evaluate

1. A carrier of frequency fc=100 kHz DSB-SC modulated by a message signal x(t)=cos2000*pi*t+2cos4000*pi*t to give a modulated signal xc(t)=50x(t)cos2*pi*105t
   a. Sketch the spectrum of xc(t), the modulated signal.
   b. Find the average powers of all the frequency components in xc(t).

2. A DSB-SC signal is transmitted over a channel with additive white noise of two-sided PSD of (ή/2)=0.5* 10-12 W/Hz. if the received signal power is SR =20*10-19 W and the message bandwidthW=5*106 Hz, find the destination SNR.
3. Making use of the Bessel function tables, sketch the spectrum of an angle-modulated signal for fm=5 kHz and β=smallest value of β for which the carrier components vanishes. Sketch the 2-sided spectrum up to the 3rd side-frequency component.

15EC404 MICROPROCESSORS AND MICROCONTROLLERS 3 0 0 3

Course Objectives

- To understandarchitecture and assembly language programming of microprocessor and microcontroller
- To understand the concept of interrupts and interfacing with various peripherals.
- To realize the features of a microcontroller and its timer applications.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Describe the architectural features and develop an ALP of 8085 using appropriate instruction set and addressing modes.
2. Develop an ALP for machine level program processing using 8086 instruction set, addressing modes and analyze the impacts of interrupts.
3. Analyze the communication interface techniques used between the peripheral devices and microprocessor.
4. Explain the operational features, addressing modes and instruction set of PIC microcontroller and analyze the concept of pipelining.
5. Analyze the timers and interrupts of PIC Controller.

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

UNIT I **9 Hours**

8085MICROPROCESOR

8085 Architecture - Instruction set - Addressing modes - Timing diagrams -Assembly language programming - Interrupts - Memory & I/O device interfacing.

UNIT II **9 Hours**

8086 MICROPROCESSOR

Intel 8086 Internal Architecture - Register organization, Modes of Operation- memory segmentation and physical address computations - I/O addressing capability - Minimum mode and maximum mode - Addressing modes- Instruction set, Interrupt and Interrupt service routines, Assembly language Programming.

UNIT III **9 Hours**

INTERFACING

Programmable peripheral interface (8255), Keyboard and seven segment display interface (8279), DMA controller (8237), ADC Interfacing, USART (8251).

UNIT IV **9 Hours**

PIC MICROCONTROLLER

PIC Microcontroller: CPU Architecture and instruction sets: Hardware architecture and pipelining - program memory consideration - register file structure and addressing modes - CPU Register - instruction set.

UNIT V **9 Hours**

TIMERS OF PIC MICROCONTROLLER

Timer and interrupts: timer use - interrupt logic-timer2 scalar initialization. External interrupts and timers: timer0 compare / capture mode - timer1/ CCP programmable period scalar. Timer1 and sleep mode-PWM O/P

FOR FURTHER READING

Programming with an assembler-Assembly language example programs, Programming 8086 with Traffic Light Controller, Reset Controller Module, Clock Module, System Control Module, Chip Configuration Module.

Total: 45 Hours

Reference(s)

1. Ramesh S. Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Fourth edition, Penram International, 2002.

2. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals Architecture, Programming and Interface", Tata McGraw Hill, 2006.
3. John B.Peatman, Design with PIC Microcontrollers, Pearson Education Asia, 2002.
4. V.Douglas Hall, Microprocessors and Interfacing Programming and Hardware, TataMcGraw Hill, 2008.
5. Yu. Cheng Liu & Glenn A Gibson, "Microcomputer System, 8086/8088Family", 2nd Edition, PHI, 2000.
6. Rafiquzzaman.M. "Microprocessor Theory and Applications-Intel and Motorola", PHI, 2007.

Assessment Pattern

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

Assessment Questions

1. Define Microprocessor and give the power supply & clock frequency of 8085.
2. List out few applications of microprocessor-based system
3. List out the allowed register pairs of 8085.
4. List out the interrupts of 8085.
5. List out features of 8086 microprocessor.
6. Name the functional units of 8086 microprocessor
7. Explain the functions of an accumulator.
8. Name the registers of 8086
9. List out advantages of memory segmentation
10. List the operating modes of 8086.
11. List the minimum mode signals.
12. List the maximum mode signals.
13. Define addressing mode. Write the names of 8086 addressing an example.
14. Define & explain the use of relative plus addressing mode
15. Define assembler directive. Give any two examples
16. List out the features of the 8255(PPI).
17. Write how many port lines are present in 8255.
18. Define Memory mapped I/O
19. List out the methods available for ADC.
20. Define I/O mapped I/O.
21. Define interrupt vector table.
22. Define Baud rate.
23. List out the serial communication standards available.
24. List out the features of 8251(USART).
25. List out the types of addressing modes in PIC microcontroller
26. List out the on-chip resources available in PIC microcontroller.
27. List all the CPU registers in PIC microcontroller
28. List out few instruction set in PIC microcontroller

Understand

1. Explain why 8086 internal architecture is divided into BIU &
2. Discuss the functions of BIU.
3. Discuss about pipelining.
4. Describe the flag register of 8086.
5. Discuss how physical address is generated in 8086.
6. Explain the physical memory organization of 8086.
7. Explain ALE,BHE/S7, DEN, DT/R.
8. Indicate the interrupts of 8086.
9. Explain READY, MN/ MX' HOLD, and HOLDA.
10. Explain hardware interrupts.
11. Explain the instructions formats in 8086.
12. Discuss about the immediate addressing mode of 8086 with examples
13. Explain PUSH & POP instructions.
14. Explain XLAT instructions.
15. Explain stack pointer & instruction pointer.
16. Explain IN & OUT instructions.
17. Explain why I/O interface required for 8086.
18. Discuss in how many modes 8255 can be operated.
19. Discuss the need for ADC.
20. Explain the function of handshaking signals
21. Distinguish between static and dynamic RAM with examples.
22. Explain the purpose of BHE and A0 pins on the 8086microprocessor.
23. Explain the purpose of CE or CS pin on a memory chip.
24. Distinguish the difference between Maskable and Non- Maskable interrupts.
25. Explain with an example how overflow flag set.
26. Explain what happens when trap flag is set.
27. Explain why serial data transfer is preferred over parallel data transfer.
28. Describe and sketch the frame format of mode word of 8251
29. Describe the status register of 8251.
30. Explain how external interrupts are serviced in Microcontroller
31. Explain how to save the status of Port A in RAM location 31.
32. Explain why Port B needs pull-up resistors.

Apply

1. Illustrate the difference between intersegment & intra-segment jumps.
2. Interface two 4k×8EPROMS and two4k×8 RAM chips with8086.Select suitable memory map
3. Calculate the control port address of 8255 if the base address
4. Write any two address transfer instructions.
5. Calculate baud rate in mode-1 operation.
6. Sketch and illustrate how to access external memory devices in an microcontroller based system
7. Demonstrate the functioning of W & PC registers of microcontroller.
8. Calculate the physical address is represented by i) 4370:561EH ii) 7A32:0028H
9. Construct an Interfacing DAC AD7523 with an 8086 CPU running at 8MHZ and write an assembly language program to generate a sawtooth waveform of period 1ms with Vmax 5V
10. Construct an interface two chips of 32k × 8 PROM & four chips of 32k × 8 RAM with 8086, according to the Following map. ROM 1 & 2 F0000H-FFFFFH, RAM 1 & 2 D0000H- DFFFFH RAM 3 & 4 E0000H-EFFFFH. Show the implementation of this memory system.

11. Illustrate the status register of 8251 for the given statement. Read status register and wait for DSR and TxRDY to become active. One active, get character from PC keyboard using INT B8H (keyboard routine).

Analyze

1. Analyze the storage allocation directives.
2. Write about the sources of interrupts.
3. Differentiate the given instructions: MVI and MOV
4. Compare 8085 & 8086 microprocessors.
5. Model a Control Words When the Port of Intel 8255A defined as follows: Port A as an O/P port, mode of the port A is mode-0, port B as an O/P port, mode of the Port B is mode-0.
6. Use PUSH instruction to put the number 82H in RAM locations 34H to 37H. also write same program without PUSH instruction
7. Examine the TH1, TL1 value to generate a time delay of 5ms. Timer 1 is programmable in mode 1. Assume that XTAL = 16MHz

Evaluate

1. Evaluate the physical address, if base address is 5200H & offset address is 4510H.
2. Evaluate the physical address of the top of the stack? If the stack segment register contains 3000h and the stack pointer register contains 8434H.
3. The original contents of AX, BL, word-sized memory location SUM, and carry flag CF are 1234H, ABH, 00CDH, and 0H, respectively. Describe the results of executing the following sequence of instructions: ADD AX, [SUM],ADC BL, 05H , INC WORD PTR [SUM]

Create

1. Write an ALP to convert given sixteen bit binary number to its gray equivalent.
2. Write a delay loop which produces a delay of 500µsecon an8086 with5-MHzclock.
3. Write BSR control word of 8255to set pc2 &pc7& reset them after a time delay. Base address of 8255 is F800H
4. Write a program for 8-bit ADC to sample analog input & store the digital value in memory
5. Write an ALP for to interface LED with PORT 0 by using 8255
6. Develop a Program Timer0 to generate a square wave of 3 kHz. Assume that XTAL=11.0592MHz using Microcontroller.
7. Write an assembly language program to find number of positive & negative numbers from a given array.
8. Write an ALP for stepper motor interfacing by using loop instructions.

15EC405 CMOS VLSI DESIGN 3 0 0 3

Course Objectives

- Understand the CMOS Fabrication Process and CMOS Circuits
- Study CMOS Circuits using various Logic Styles
- Provide basic knowledge about Clocking, Memory and VLSI Subsystem 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.
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.
PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Design a digital CMOS logic circuit and develop an optimum layout for IC fabrication.
2. Analyse the DC, power dissipation and switching characteristics of CMOS inverter circuit.
3. Design a digital logic circuit for boolean function using various CMOS logic styles and evaluate the design area, delay and power characteristics.
4. Design a various flip flop and apply for CMOS memory.
5. Apply CMOS logic to design a various digital submodule for VLSI system design.

Articulation Matrix

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

UNIT I **9 Hours**

FABRICATION OF CMOS IC AND PHYSICAL DESIGN

An overview of Silicon Semiconductor technology- NMOS fabrication - CMOS fabrication: n-well, pwell - Twin tub and SOI Process- Layout design rules- Lambda Design Rules Stick Diagrams-VLSI Layout Design -Full Custom and Semi Custom Layout- Layout of Basic Structures - CMOS Logic Gates - Implementation of given logic function using CMOS logic-Basics of MEMS.

UNIT II **9 Hours**

MOS CIRCUIT DESIGN PROCESS

Basic MOS transistors: symbols, Enhancement mode - Depletion mode transistor operation - Threshold voltage derivation - Body effect - Drain current Vs voltage derivation - channel length modulation. NMOS inverter- Determination of pull up to pull down ratio-CMOS inverter - DC Characteristics-Switching Characteristics Power dissipation NAND and NOR Gate Transient Response Transistor Sizing

UNIT III **9 Hours**

CMOS LOGIC STYLES

Pass Transistor and Transmission Gate Static CMOS design, Tri-State Circuits- Pseudo Nmos -dynamic CMOS logic Clocked CMOS logic Precharged domino logic- Keeper Circuits - Dual Rail- Cascode Voltage Switch Logic-Circuit Pit Falls.

UNIT IV **9 Hours**

CMOS MEMORIES AND CLOCKING

Conventional CMOS Latches CMOS D Flip Fop SDFF - TSPC Flip Flop - CMOS Static RAM Dual Port SRAM - SRAM Arrays - DRAM and Floating Gate MOSFET - Flash Memory CMOS Clocking Styles Pipelined Systems

UNIT V **9 Hours**

VLSI SUBSYSTEM DESIGN

CMOS Mux - Equality Detector - Shift and Rotation Operation - Parity generators- Ripple Carry Adder-Carry Look Ahead Adder -Carry Skip Adder - Carry select - Carry save-Array - Braun/ Baugh Wooley - Modified Booth Encoded Multiplier

FOR FURTHER READING

Comparison of Logic Styles - Differential and Sense Amplifier Circuits Prescaler - Bit Slice - ALU CMOS Clock Generation and Distributions - BICMOS- FINFET Technology

Total: 45 Hours

Reference(s)

1. John P.Uyemura, "Introduction to VLSI circuits and systems", John Wiley
2. Neil.H.E Weste David Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition, Pearson Addison Wesley, 2015.
3. Kamran Eshraghian, Douglas A. Pucknell, Essentials of VLSI Circuits and Systems Prentice Hall of India, 2015
4. ColdFire Family Programmers Reference Manual, Freescale Semiconductors,2005.
5. Keng,Lable bick,"CMOS Digital Integrated Circuits", Tata McGraw Hill, 2014
6. Jan M Rabaey, Digital Integrated Circuits- A Design, Prentice Hall, Dec 2015

Assessment Pattern

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

Assessment Questions

Remember

1. Define photolithography
2. Define Ion implantation
3. Mention the types of power dissipation in CMOS circuits
4. Explain the operation of NMOS depletion mode transistor also draw the drain and transfer characteristics.
5. Execute the expression for threshold voltage of MOS transistor
6. Define Precharge and Evaluation. Also explain the working principle of Dynamic CMOS logic circuits

7. Define body effect.
8. Illustrate the steps involved in VLSI design process.
9. Discuss the process involved in ion implantation and deposition
10. List the advantages of twin tub process.
11. Draw the block diagram of 4-bit ripple carry adder (RCA).

Understand

1. Explain the working principle of CMOS transmission gate and draw the characteristics of the same.
2. Differentiate depletion mode and enhancement type MOSFET
3. Explain transient characteristics of CMOS inverter also calculate the Rise time, Fall time and Delay time. And also mention why fault time is faster than rise time
4. Draw the waveform for DC characteristics of CMOS inverter and also explain the three regions of operation in inverter
5. Illustrate the various processing steps involved in n-well process for CMOS inverter.
6. Illustrate the various processing steps involved in p-well process for CMOS inverter
7. Illustrate the different masks used in twin tub process.
8. Differentiate array and tree multiplier
9. Illustrate the structure of 4X4 Wallace tree multiplier, and compare array and tree multiplier with suitable example.
10. Enumerate on pipelining system technique.
11. Explain the various CMOS clocking styles.

Apply

1. How to reduce the leakage current in the Clocked CMOS logic circuit?
2. Design an XNOR gate using dynamic CMOS logic.
3. Design of D-Latch using CMOS transmission gate.
4. Implement the CMOS TG realization of F = AB+AC+ABC.
5. Implement y= AB+CD by using Domino CMOS structure.
6. Determination of pull up to pull down ratio for an NMOS inverter.
7. Derive the expression for switching energy per transition in CMOS inverter circuits. And how the Energy Transferred out of the power supply during low- high transition at the output.
8. Implement the Boolean function F= A+B. (C+D) using static CMOS logic.
9. Elucidate the various processing steps involved in twin Tub Process with neat diagrams.
10. Design 2X2 array multiplier using adders and AND gate.
11. Apply carry save algorithm to design 2X2 multiplier.
12. Design of 4X4 –bit Non-additive multiplier. And also explain the Algorithm of Non-additive multiplier.
13. Illustrate the structure of 4X4 Braun multiplier using carry save algorithm.
14. Design CMOS 6T SRAM cell.

Analyse

1. Design a tri-state circuits inverter and compare the operations of CMOS inverter circuits.
2. Why NMOS technology is preferred more than PMOS technology?
3. Compare between CMOS and Bipolar technologies.
4. Compare n-well and p-well Process.
5. Compare twin tub process and silicon gate nMOS process.
6. Why SOI process is preferred for some application even though cost is high?
7. Compare the architecture of carry look ahead adder and carry select adder with suitable diagram.
8. Contrast SRAM and DRAM.
9. Compare Dynamic and Flash memory.

Evaluate

1. Elucidate the basic theory and operation of 4X4 Braun multiplier with a neat sketch and evaulate the Delay, speed performance of Braun multiplier.

Create

1. Construct the following example multiply using booth multiplier (3x-4).
2. Construct the schematic diagram of a 4x4 Array multiplier.

15EC406 ELECTROMAGNETIC FIELDS AND WAVEGUIDES **3 2 0 4**

Course Objectives

- To gain knowledge on vector calculus.
- To acquire knowledge of various static electric and magnetic fields
- To gain knowledge on different applications of electromagnetic fields.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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.
PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Compute and analyse the behaviour of static electric field of various geometries and its scalar potential using Coulomb's Law and Gauss Law.
2. Compute and analyze the behaviour of static magnetic field of various geometries and its vector potential using Biot-Savart Law and Ampere's Circuital Law.
3. Mathematically analyze the boundary conditions of electric and magnetic field and determine the capacitance and inductance of various geometries.
4. Interpret the time varying Maxwell's Equation of Electric and Magnetic fields and characterize TE, TM and TEM waves.
5. Analyze the characteristics of TE and TM waves and its effect on attenuation in rectangular waveguide.

Articulation Matrix

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

UNIT I **9 Hours**

ELECTROSTATIC FIELDS

Vector analysis- Coordinate systems and Vector Calculus. Coulomb's Law in Vector Form -Electric Field Intensity -Electric Field due to discrete charges - Electric field due to continuous charge distribution - Electric Field due to charges distributed uniformly on a finite line - Electric Field on the axis of a uniformly charged circular disc and uniformly charged sheet. Electric Scalar Potential - Relationship between potential and electric field - Electric Flux Density -Electrostatic energy and energy density - Gauss Law and Applications

UNIT II **9 Hours**

STATIC MAGNETIC FIELD

The Biot-Savart Law in vector form - Magnetic Field intensity due to a finite and infinite wire carrying a current I - Magnetic field intensity on the axis of a circular loop carrying a current I - Ampere's circuital law and simple applications. Magnetic flux density - The Lorentz force equation for a moving charge and applications - Force on a wire carrying a current I placed in a magnetic field -Magnetic Vector Potential

UNIT III **9 Hours**

ELECTRIC AND MAGNETIC FIELDS IN MATERIAL SPACE AND BOUNDARY VALUE PROBLEMS

Properties of materials- convection and conduction current-conductors- polarization in dielectrics- types of dielectrics- continuity equation and relaxation time- Boundary conditions for electric fields - Definition of Capacitance - Capacitance of various geometries using Laplace's equation- - method of images. Classification of magnetic materials - magnetic boundary conditions- inductors-inductances - magnetic energy.

UNIT IV **9 Hours**

GUIDED WAVES

Introduction of Maxwell-s equations from Faraday's Ampere's law and Gauss's law for time varying fields. Waves between parallel planes of perfect conductors, Transverse electric and transverse magnetic waves characteristics of TE and TM Waves, Transverse Electromagnetic waves, Velocities of propagation, Wave impedances.

UNIT V **9 Hours**

RECTANGULAR AND CIRCULAR WAVEGUIDES

TM and TE Waves in Rectangular Wave guides, characteristic of TE and TM Waves, Cut-off wavelength and phase velocity ,Impossibility of TEM waves in wave guides, Dominant mode in rectangular wave guide, Attenuation of TE and TM modes in rectangular wave guides.

FOR FURTHER READING

Deflection of charged particle- CRO- ink jet printer- electrostatic generator- electrostatic voltmeter- magnetic deflection- velocity selector and mass spectrometer- Hall effect- magneto hydrodynamic generator- electromagnetic pump.

Total: 75 Hours

Text Book(s)

1. Mathew N O Sadiku, Electromagnetic Fields, Oxford University Press, 6th edition, 2014

Reference(s)

1. Bhag Guru and HuseyinHiziroglu, Electromagnetic Field Theory Fundamentals, Cambridge University Press, 2nd edition, 2004
2. William H Hayt, John A Buck, Engineering Electromagnetics, McGraw-Hill Higher Education, 8th edition, 2011

3. John D Kraus, Electromagnetics with Applications, McGraw-Hill Science/Engineering/Math, 5th edition, 1999

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					4				4				6										18
2		2					4				6			8					8						28
3	2					4				6					6										18
4	2					4					8								6						20
5		2				2				4				4				4							16
																								Total	100

Assessment Questions

Remember

1. State Divergence theorem.
2. Define Curl.
3. State Gauss law and electric flux density.
4. Define Electric field Intensity.
5. State Coulomb’s law and express it in vector form.
6. State Biot-Savart law and express it in vector form.
7. Define Faraday’s Law and write its equation.
8. Derive Laplace’s and Poisson’s equations from fundamentals.
9. Write the four Maxwell’s equation for time varying fields.
10. Provide the boundary condition for the normal component of the magnetic field intensity vector at the interface between two magnetic materials.

Understand

1. Define gradient and write its mathematical expression in cylindrical and Spherical Coordinates.
2. Indicate the way to convert the point one coordinates system to other systems.
3. Give the limitations of Gauss’s law.
4. Represent the electric fields by using coulomb’s law.
5. Identify the infinite sheet of charge and volume charge.
6. Represent the point charge, infinite sheet charge using by Gauss law.
7. In what form energy is stored in electric field?
8. Indicate the capacitance in the parallel plate and Co-axial cable Capacitor.
9. Identify the magnetic field intensity of infinitely long coaxial transmission line.
10. Differentiate Gradient, Divergence and Curl with essential mathematical expressions.
11. Interpret polarization and linear polarization in dielectrics.

Apply

1. Apply the Ampere’s law into infinite sheet of current & find the magnetic field intensity Convert point P (-2, 6,3) from cartesian to cylindrical and sphericalco-ordinates.
2. A current of 2 A is flowing in an inductor of inductance 100 mH. What is the energy stored in the inductor?
3. A plane wave traveling in air is normally incident on a block of paraffin with εr=2.2. Find the reflection and transmission coefficient.
4. A coaxial cable contains an insulating material of conductivity σ. If the radius of the central wire is ‘a’ and thickness is ‘b’, find the conductance of the cable per unit length.
5. Briefly explain reflection by a perfect dielectric when a wave is incident normally on a perfect dielectric and derive expression for reflection coefficient.

6. The current density at the surface of a thick metal plate is 100A/square metre. What is the skin depth if the current density at a depth of 0.01 cm is 28A/square metre?
7. State and explain faradays and lenzs law of induction and derive maxwells equation.
8. Derive an expression for the capacitance of a parallel plate capacitor having two dielectric media.
9. Derive the expression for vector magnetic potential.
10. Using Biot-savart's law obtain the expression for the magnetic field intensity due to a circular loop carrying current in the anti-clockwise direction.

Analyse

1. Estimate the boundary condition at the interface between two dielectric medium.
2. Investigate the Maxwell’s equation derived from Faraday’s law.
3. An iron ring with a cross-sectional area of 4 square cm and a mean circumference of 18 square cm is wound with 260 turns of wire carrying a current of 0.5A. The relative permeability of the ring is 1800. Calculate the flux established in the ring.
4. Determine the capacitance of a capacitor consisting of two parallel metal plates 20cm x 20cm surface area, separated by 4 mm in air. What is the total energy stored by the capacitor if the capacitor is charged to a potential difference of 300V? What is the energy density?
5. Derive the boundary relations for electric fields.
6. Determine the force per meter length between two long parallel wires A and B separated by 6 cm in air and carrying currents of 30A in the same direction.
7. Determine the electric field intensity of a straight uniformly charged wire of length 'L' m and having alinear charge density of +ρC/m at any point at a distance of 'h' m. Hence deduce the expression for infinetly long conductor.
8. Derive the expression for the inductance of a toroidal coil with N turns carrying current I and the radius of the toroid R.
9. Using ampere's circuit law determine the magnetic field intensitydue to infinite long wire carrying a current I.
10. Compare gradient, divergence and curl in three different co-ordinates systems.

Create

1. Derive the electromagnetic wave equations in phasor form.
2. Derive the electrostatic boundary conditions at the interface between two dielectrics.

15EC407 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY — 0 0 2 1

Course Objectives

- To understand and analyse instruction sets of 8085, 8086 microprocessor and PIC micro controller.
- To Gain hands-on experience in doing experiments on microprocessors (8085 and 8086) and microcontroller.
- To interface the microprocessor / microcontroller with various peripherals for various applications
- Able to use an Integrated Development Environment (IDE) as a modern software tool for embedded system development.

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Perform the basic operations of 8085/8086 microprocessor using Assembly language programming.
2. Perform various operations like sorting, finding the maximum & minimum numbers and string operations using 8085/8086 microprocessor.
3. Interface 8085/8086 microprocessor to implement various operations like ADC,DAC, 8279 , Traffic Light controller etc.,
4. Perform basic operations using PIC Microcontroller
5. Generate an interrupt, LED operations using push button and input capture operations using PIC microcontroller

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

1 **2 Hours**

EXPERIMENT 1

Addition and subtraction of two numbers using 8085/8086

2 **2 Hours**

EXPERIMENT 2

Multiplication and division of two numbers using 8085/8086

3 **2 Hours**

EXPERIMENT 3

Maximum and Minimum number in an array of data using 8085/8086

4 **2 Hours**

EXPERIMENT 4

Sorting of numbers using 8085/8086

5 **2 Hours**

EXPERIMENT 5

String manipulation operations using 8086. (String transfer, Search, Find)

6 **4 Hours**

EXPERIMENT 6
Interfacing 8085/8086 with 8279, 8251

7 **2 Hours**

EXPERIMENT 7
Interfacing 8085/8086 ADC and DAC.

8 **2 Hours**

EXPERIMENT 8
Interfacing 8085/8086 with elevator controller

9 **4 Hours**

EXPERIMENT 9
Interfacing 8085/8086 with Traffic light controller

10 **4 Hours**

EXPERIMENT 10
LED Blinking, Digital Inputs and outputs using Microcontrollers

11 **4 Hours**

EXPERIMENT 11
Interrupt, Buzzer and Input Capture using Microcontrollers

Total: 30 Hours

Reference(s)

1. A.K.Ray, K.M.Bhurchandi, Advanced Microprocessors and Peripherals-Architecture, Programming and Interface, Tata McGraw Hill,2006.
2. V.Douglas Hall, Microprocessors and Interfacing Programming and Hardware, Tata McGraw Hill,2008.
3. Rafiquzzaman.M. "Microprocessor Theory and Applications-Intel and Motorola", PHI, 2007.
4. Yu. Cheng Liu & Glenn A Gibson, "Microcomputer System, 8086/8088Family", 2nd Edition, PHI, 2000

15EC408 COMMUNICATION SYSTEMS LABORATORY

0 0 2 1

Course Objectives

- To provide an introduction on different analog modulation and demodulation systems
- To study the Characteristics of AM receiver and FM receiver
- To learn Pre-emphasis and de-emphasis in FM

Programme Outcomes (POs)

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

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Design the modulator and demodulator circuits for DSB-FC and DSB-SC Amplitude modulation techniques
2. Design the modulator and demodulator circuits for Frequency modulation technique
3. Analyze the concept of Pulse Modulation techniques through ideal and practical cases
4. Analyze the frequency spectrum of different AM and FM schemes using MATLAB
5. Analyze the noise performance of AM and FM receivers

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Design of transistor based Amplitude modulator and envelope detector.

2 **2 Hours**

EXPERIMENT 2

Generation of DSB-SC using Ring Modulator

3 **2 Hours**

EXPERIMENT 3

Design of Frequency modulator and demodulator.

4 **4 Hours**

EXPERIMENT 4

Capture and lock range of Phase Locked Loop

5 **2 Hours**

EXPERIMENT 5

Design Pre-emphasis and de-emphasis in FM

6 **4 Hours**

EXPERIMENT 6

Design of Mixer circuits

7 **4 Hours**

EXPERIMENT 7

Generation of PAM, PPM and PWM

8 **2 Hours**

EXPERIMENT 8

Frequency spectrum analysis of various AM modulation systems

9 **2 Hours**

EXPERIMENT 9

Coherent and non-coherent detection of DSB-FC

10 **2 Hours**

EXPERIMENT 10

Frequency spectrum analysis of Narrow band and Wide band FM

11 **2 Hours**

EXPERIMENT 11

Simulation of PAM, PPM and PWM

12 **2 Hours**

EXPERIMENT 12

Analysis of Gaussian noise through LTI filter

Total: 30 Hours

Reference(s)

1. Bruce Carlson et al, Communication systems, McGraw-Hill,2002.
2. Simon Haykin, Communication Systems, John Wiley, 2001
3. P.Michael Fitz, Fundamentals of Communication System, Tata McGraw-Hill -2008.
4. P.Rama Krishna rao, Analog Communication, Tata McGraw-Hill -2011
5. Taub and Schilling, Principles of communication systems, Tata McGraw-Hill, 1995.
6. Bruce Carlson et al, Communication systems, McGraw-Hill,2002.

15EC409 MINI PROJECT II **0 0 2 1**

Course Objectives

- Speculate the problem identifying ability
- Improve the analyzing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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 ones 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. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Articulation Matrix

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

Total: 30 Hours

15GE410 LIFE SKILLS: VERBAL ABILITY 0 0 2 0

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

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

Articulation Matrix

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

1 **15 Hours**

UNIT 1

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

2 **15 Hours**

UNIT 2

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

Total: 30 Hours

Reference(s)

1. Raymond Murphy. ENGLISH GRAMMAR IN USE - A SELF-STUDY REFERENCE AND PRACTICE BOOK FOR INTERMEDIATE LEARNERS OF ENGLISH.IVed. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. WORD POWER MADE EASY. Goyal Saab Publisher, 2011.
3. BARON'S THE OFFICIAL GUIDE FOR NEW GMAT REVIEW 2015. New Jersey : John Wiley & Sons, Inc.

15EC501 DIGITAL SIGNAL PROCESSING 3 2 0 4

Course Objectives

- To design IIR and FIR filters for given specifications by following the suitable design procedures
- To analyze the finite word length effect in the design of digital signal processing systems
- To analyze the sampling rate conversion in digital domain using the multi rate signal processing techniques
- To understand the architectural overview and addressing modes in DSP processors

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Design IIR filter, analyse its response & construct its realization structure.
2. Design FIR filter, analyse its response & construct its realization structure.
3. Analyze the effect of finite word length for fixed & floating point number representation.
4. Apply the concept of sampling rate conversion for the design of digital filter system.
5. Develope algorithm using TSM320C5X Processor for simple signal processing applications.

Articulation Matrix

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

UNIT I **13 Hours**

INFINITE IMPULSE RESPONSE DIGITAL FILTERS

Design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain - Design of IIR digital filters using impulse invariance technique- Design of digital filters using bilinear transform -pre warping -Realization of IIR Digital filters, Realization using direct, cascade and parallel forms.

UNIT II **12 Hours**

FINITE IMPULSE RESPONSE DIGITAL FILTERS

Symmetric and Anti symmetric FIR filters- Linear phase FIR filters- Design using Frequency sampling technique-Window design using Rectangular, Hamming and Hanning Windows - Realization of FIR filters-Transversal, Linear phase realization structures.

UNIT III **7 Hours**

FINITE WORD LENGTH EFFECTS

Number representation of binary and floating point quantization noise-derivation for quantization noise power -Fixed point and binary floating point number representation comparison-over flow error -truncation error -Product quantization error, co-efficient quantization error- limit cycle oscillation.

UNIT IV **7 Hours**

MULTIRATE DIGITAL SIGNAL PROCESSING

Sampling rate conversion -Decimation by an integer factor-interpolation by an integer factor-Sampling rate conversion by a rational factor -poly-phase FIR structures - FIR structures with time varying coefficients.

UNIT V **6 Hours**

DIGITAL SIGNAL PROCESSORS

Introduction to DSP architecture-Harvard architecture - Dedicated MAC unit - Multiple ALUs, Pipelining, VLIW instruction set of TMS320C5X, addressing modes and simple programming examples.

FOR FURTHER READING

Lattice structure of IIR and FIR filters, Kaiser Window, quantization error in FFT algorithm, applications of Multirate systems, architecture of TMS320C6X, code composer studio.

Total: 75 Hours

Reference(s)

1. Alan V. Oppenheim, Ronald W Schafer, John R Beck, Discrete Time Signal Processing, PHI, 2014
2. Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, 2015
3. Richard G. Lyons, Understanding Digital Signal Processing, Prentice Hall, 3rd Edition, 2010
4. S.K.Mitra, Digital Signal Processing- A Computer based approach, Tata McGraw-Hill, 3rd Edition, 2011.
5. S. Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill, 2nd Edition, 2011

Assessment Pattern

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

Assessment Questions

Remember

1. State the parameters that can be obtained from the chebyshev filter specification.
2. Mention any two procedures for digitizing the transfer function of an analog filter.
3. List the well known design technique for linear phase FIR filter design.
4. Define Gibbs phenomenon.
5. Compare the fixed point and floating point arithmetic.
6. How can overflow limit cycles be eliminated?
7. Write a short notes on any two special addressing modes in DSPs.
8. Contrast the difference between von Neumann and Harvard architecture.
9. Define downsampling.
10. Define multirate signal processing.

Understand

1. Interpret the equation for the order of N and cut off frequency Ω c of Butterworth filter.
2. Represent the digital filter transfer function if all poles of analog filter are specified.
3. Write the steps involved in FIR filter design?
4. What is the necessary and sufficient condition for the linear phase characteristic of a FIR filter?
5. Express the fraction 7/8 and -7/8 in sign magnitude, 2’s complement and 1’s Complement.
6. List out the different types of fixed point number representation.
7. Identify the on chip peripherals of CPU of TMS320C5x processors.
8. Characterize the total memory space in TMS320C5x processors and how it is divided between program, data and IO.

9. If the z transform of a sequence x(n) is X(z) then what is the z transform of a sequence upsampled by a factor L.
10. If the z transform of a sequence x(n) is X(z) then what is the z transform of a sequence downsampled by a factor M.

Apply

1. Using the bilinear transform, design a high pass filter, monotonic in pass band with cutoff frequency of 1000Hz and down 10dB at350Hz.The sampling frequency is 5000Hz.
2. Design a Butterworth high pass filter satisfying the following specifications α p =0.5dB; α s =30dB; f p =0.32Hz; f s =0.16Hz; F=1Hz.
3. Design a high pass filter of length 7 samples with cut off frequency of 2 rad /sec using Hamming window. Plot its magnitude and phase response.
4. Determine dead band of the filter.
5. A causal filter is defined by the difference equation Y(n) =x(n) - 0.9y(n - 1) The unit sample response is computed such that the computed values are rounded to one decimal place. Show that the filter exhibits dead band effect. Determine the dead band range.
6. Explain the characteristics of a limit cycle oscillation with respect to the system described by the equation y(n) = 0.95y(n - 1) + x(n).
7. Write an assembly language program using instructions of TMS320C5x processor to multiply two numbers unsigned 32-bit data. Assume that the two data are available in memory. Store the 64-bit product in memory.
8. Write a short note on various functions of On-chip memory in TMS320C5x processor.
9. Explain the poly phase structure of decimator and interpolator?
10. Explain the design steps involved in the implementation of multistage sampling rate converter.

Analyse

1. For the given specifications α p =3dB; α S =15dB; Ω p =1000rad/sec and Ω s =500rad/sec design a high pass filter.
2. What is the reason that FIR filter is always Stable?
3. Why Blackman-tuckey method is preferred when compared to other windowing methods?
4. Discuss about quantization noise and derive the equation for finding quantization noise power.
5. The input to the system y(n) = 0.999y(n - 1) + x(n) is applied to an ADC. What is the power produced by the quantization noise at the output of the filter if theinput is quantized to (a) 8 bits (b) 16 bits.
6. Illustrate the following addressing mode with example i) memory mapped register ii) Bit reversed addressing.
7. Write an assembly language program using instructions of TMS320C5x processor to divide 16-bit data by an 8-bit data. Assume that the data are 2's complement positive integers available in memory. Store the quotient and remainder in memory.

Evaluate

1. Design a Chebyshev filter with a maximum passband attenuation of 2.5 dB;at Ω p =20rad/sec and the stop band attenuation of 30dB at Ω S =20rad/sec.
2. Find the effect of co-efficient quantization on pole locations of the given second order IIR system, when it is realized in direct form I and in cascade form. Assume a word length of 4 bits through truncation. H(z) = 1 / (1 – 0.9 z-1 + 0.2 z-1)
3. A signal x(n) is given by x(n) = {0,1,2,3,4,5,6,0,1,2,3....} i) Obtain the decimated signal with a factor of 2. ii) Obtain the interpolated signal with a factor of 2.

Create

1. Implement a two stage decimator for the following specifications. Sampling rate of the input signal= 20,000Hz.M=100,Passband=0 to 40 Hz,Transition band = 40 to 50 Hz. Pass band ripple = 0.01,Stop band ripple= 0.002.

2. Design a digital second order low pass Butterworth filter with cut off frequency 2200Hz using bilinear transformation. Sampling rate is 8000 Hz.

15EC502 TRANSMISSION LINES AND ANTENNAS 3 0 0 3

Course Objectives

- To understand the different types of transmission lines at radio frequencies
- To determine the radiation field of different wire antennas and analyze its parameters.
- To analyze and design travelling wave antennas and derive the radiation fields of aperture and slot antennas
- To understand the characteristics of signals in sky wave, space wave and ground wave propagation mechanisms.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Find the voltage, current and impedance of the transmission line as a function of its characteristics impedance and propagation constant
2. Analyze the characteristics of the transmission line at radio frequencies and apply smith chart for impedance matching
3. Determine the radiation fields of different wire antennas, array antennas and analyze its fundamental parameters
4. Analyze the fields of different travelling wave antennas and compute the radiation fields of the Huygen's source, aperture,slot and complementary dipole antennas
5. Analyze the refractive, reflection and attenuation characteristics of the sky wave, space wave and ground wave propagation and explain the gain and directivity measurements of the antenna.

Articulation Matrix

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

UNIT I **9 Hours**

TRANSMISSION LINE THEORY

Different types of transmission lines-Definition of characteristic impedance, the transmission line as a cascade of T Sections, Definition of Propagation Constant. General Solution of the transmission line, physical significance of the equation and the infinite line, wavelength and velocity of propagation, reflection on a line not terminated by Zo.

UNIT II **7 Hours**

THE LINE AT RADIO FREQUENCIES

Waveform distortion , distortion less transmission line , the telephone cable, Inductance loading of telephone cables. Input impedance of lossless lines. Standing waves and standing wave ratio on a line ,Input impedance of a lossless line terminated by impedance, One eighth wave line .The Smith Chart, Application of the Smith Chart, single stub matching

UNIT III **10 Hours**

ANTENNA FUNDAMENTALS AND RADIATION FIELDS OF WIRE ANTENNAS

Concept of retarded vector potential- Fields from an oscillating dipole. Current Distribution on a thin wire antenna, Hertzian dipole, half-wave dipole, quarter-wave monopole and folded dipole. Antenna Parameters, Reciprocity theorem and Friis transmission formula. Linear arrays: Expression for electric field from two element array, Principle of pattern multiplication, N-element Uniform linear array. Broadside and End-fire array- Array synthesis:Binomial array, Dolph Chebychev Array.

UNIT IV **10 Hours**

TRAVELING WAVE ANTENNAS

Radiation from a traveling wave on a wire. Analysis of V antenna. Analysis and Design of Rhombic antenna Broadband antennas: Aperture concept- Effective aperture, Huygen's principle, Uniqueness theorem, Field Equivalence principle and Duality theorem, Radiation from an elemental area of a plane wave (Huygen's Source). Radiation from a rectangular aperture treated as an array of Huygen's sources. Babinet's principle-Equivalence of fields of a slot and complementary dipole, Horn antennas, parabolic reflector antennas.

UNIT V **9 Hours**

PROPAGATION AND ANTENNA MEASUREMENTS

Sky wave propagation: Structure of the ionosphere. Effective dielectric constant of ionized region, Mechanism of refraction. Refractive index, Critical frequency. Skip distance. Effect of earth's magnetic field. Maximum usable frequency. Fading and Diversity reception. Space wave propagation: Reflection from ground for vertically and horizontally polarized waves. Reflection characteristics of earth.Duct propagation. Ground wave propagation: Attenuation characteristics for ground wave propagation. Antenna measurements: Gain Measurement and Directivity Measurement

FOR FURTHER READING

Radiation from small loop and its radiation resistance. Adaptive arrays and Smart antennas. Log periodic antenna. Microstrip Patch antennas. Reconfigurable antennas. Dielectric antennas.

Total: 45 Hours

Reference(s)

1. J.D.Ryder, "Networks, Lines and Fields", PHI, 2nd Edition, 2010.
2. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems" Prentice Hall of India 2nd edition 2003.
3. Constantine A.Balanis , Antenna Theory , John Wiley, 2005
4. K.D.Prasad., Antennas and wave propagation, SathyaPraksham, 2001
5. John.D.Kraus and RonalatoryMarhefka, Antennas, Tata McGraw-Hill, 2002
6. R.E.Collins, Antennas and Radio Propagation, McGraw-Hill, 1987

Assessment Pattern

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

Assessment Questions

Remember

1. State the properties of infinite line.
2. Give the input impedance of a open and short circuit line.
3. Write the Campbell’s formula for propagation constant of a loaded line?
4. Name few applications of half – wave line.
5. List the advantages of double stub matching over single stub matching.
6. What are the characteristics of TEM waves?
7. Give the expression that relates phase velocity (Vp), Group velocity (Vg) and free space velocity.
8. What is dominant mode? Give examples.
9. Write down the expression for cut off wavelength and cut off frequency.
10. Give the expression for the guide wavelength when the wave transmitted in between two parallel plates.
11. What are the dominant mode and degenerate modes in rectangular wave – guides?
12. What is meant by the dominant mode of a waveguide?. what is the dominat mode in rectangular waveguide
13. What are the advantages of dominant mode propagation?
14. Define the quality factor of a resonator.
15. Define Bessel’s function
16. Expression for the quality factor of the circular cavity resonator.

Understand

1. Write the condition for a distortion less line?
2. Differentiate between lumped and distributed parameters.
3. Draw the equivalent circuit of a TL.
4. What are constant S circles?
5. Why do standing waves exist on TL?
6. Find the VSWR and reflection co – efficient of a perfectly matched line with no reflection from load.
7. Distinguish between single stub matching and double stub matching.
8. Explain double stub matching on a transmission line and derive the expression and the length of the stub used for matching on a line.
9. Distinguish between TE and TM waves.
10. Find the frequency of minimum attenuation of TM waves.
11. Draw a neat sketch showing the variation in the value of attenuation with frequency.
12. Compare the difference between wavegide and co axial cable.
13. Examine the TE mode field pattern in rectangular waveguide.
14. Explain about excitation modes in rectangular wave guide.
15. Define loaded and unloaded Q cavity resonator.
16. Expression for the resonant frequency of the circular cavity resonator.
17. Write expressions for the Eigen value and cut off wave number for the TE mode?
18. Derive the expression for the resonant frequency of the semi circular cavity resonator?

Apply

1. Derive the expression for input impedance of lossless line.
2. Derive the relationship between standing wave ratio and reflection co – efficient.
3. Derive the expression for the input impedance of the dissipation less line and the expression for the input impedance of a quarter wave line. Also discuss the application of quarter wave line.
4. A 30 m long lossless transmission line with characteristic impedance (zo) of 50 ohm is terminated by a load impedance (ZL) = 60 + j40 ohm. The operating wavelength is 90 m. find the input impedance and SWR using smith chart.
5. Derive the expression for wave impedance of TE, TM and TEM wave between a pair of perfectly conducting planes?
6. Derive the field configuration, cut off frequency and velocity of propagation for TM waves in rectangular wave – guides.
7. Derive the expression for attenuation of TM 11 waves in rectangular waveguide.
8. Derive the Q-factor of a rectangular cavity resonator.
9. What is meant by cavity resonator? Derive the expression for the resonant frequency of the rectangular cavity resonator.
10. Derive the TE wave components in circular wave guides using Bessel functions.

Analyse

1. Explain in details about the reflection on a line not terminated in its characteristic impedance (z0).
2. Discuss in details about inductance loading of telephone cables and derive the attenuation constant and phase constant and velocity of signal transmission for the uniformly loaded cable.
3. Discuss the characteristics of TE and TM waves and also derive the cut off frequency and phase velocity from the propagation constant.
4. Derive the expression for the field strength for TE waves between parallel plates propagating in Z direction?
5. Analyze the characteristics of transverse electromagnetic waves between a pair of perfectly conducting planes?
6. How are waveguides different from normal two wire transmission lines? Discuss the similarities and dissimilarities

7. Determine the cut – off frequency of the dominant mode for an air filled rectangular WG when a/b = 2 with a = 4cm.
8. Determine the group velocity and phase velocity for a dominant mode propagating through a waveguide of breadth 10cms at frequency 2.5GHz.
9. Discuss the characteristics of TE and TM waves and also derive the cut off frequency and phase velocity from the propagation constant.
10. Discuss few applications of cavity resonator.

Evaluate

1. Calculate the load reflection coefficient of open and short circuited lines.
2. Calculate the characteristic impedance for the following line parameters R = 10.4 ohms /km L = 0.00367 H/km C = 0.00835µf /km G = 10.8x10-6 mhos /km.

Create

1. Design a quarter wave transformers to match a load of 200 to a source resistance of 500. The operating frequency is 200 MHz.
2. Design a single stub match for a load of 150+j225 ohms for a 75 ohms line at 500 MHz using smith chart.

15EC503 EMBEDDED SYSTEMS 2 0 2 3

Course Objectives

- To study about the Architecture of Embedded System and ARM processor
- To learn the programming concepts and RTOS concepts
- To analyze various embedded communication protocols

Programme Outcomes (POs)

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

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

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

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

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

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

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones 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. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Describe about hardware and software architectures of Embedded Systems
2. Apply the functions and syntax in Embedded C Programming
3. Analyze the special features of ARM architecture for two different
4. Characterize the devices and buses used for Embedded Networking
5. Explain the concepts of a Real Time Operating System

Articulation Matrix

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

UNIT I **6 Hours**

ARCHITECTURE OF EMBEDDED SYSTEMS

Categories of embedded systems - specialties of embedded systems - Recent trends in embedded systems -Hardware architecture -Software architecture -Communication software - Process of generation of executable image -development/testing tools.

UNIT II **6 Hours**

PROGRAMMING CONCEPTS AND EMBEDDED PROGRAMMING IN C ,C

Software programming in Assembly language and in High level Language 'C' - C program elements: Header and Sources files, Preprocessor directives , Macros and Functions, Data Structures, Modifiers, Statements, Loops and Pointers - Object Oriented Programming - Embedded Programming in C++.

UNIT III **6 Hours**

ARM ARCHITECTURE

Advanced RISC Machine -Architecture Inheritance - ARM Programming Model - ARM Development Tools - 3 and 5 stages Pipeline ARM Organization - ARM Instruction Execution and Implementation - ARM Co-Processor Interface - Thumb bit in the CPSR - Thumb programmer's model.

UNIT IV **6 Hours**

EMBEDDED COMMUNICATION PROTOCOLS

Serial/Parallel Communication - Serial communication protocols - UART - RS232 standard - Serial Peripheral Interface - Inter Integrated Circuits - Ethernet - Universal serial Bus - Controller Area Network - Parallel communication protocols - ISA / PCI Bus protocols.

UNIT V **6 Hours**

REAL-TIME OPERATING SYSTEM CONCEPTS

Architecture of the Kernel- Foreground/Background Systems- Critical Sections of Code-Resources- Shared Resources- Multitasking- Tasks- Context Switches- Kernels- Schedulers-Non-Preemptive Kernels- Preemptive Kernels-Task Priorities-Static Priorities-Dynamic Priorities-Priority Inversion- Mutual Exclusion- Deadlock-Event Flags- Intertask Communication- Message Mailboxes- Message

Queues- Interrupts- Interrupt Latency-Interrupt Response- Interrupt Recovery- RTOS: RT Linux - VX Works - µCOS.

FOR FURTHER READING

Embedded System on Chip (SoC) and use of VLSI circuit design technology, Productivity Tools, Device Drivers, ARM Cores, ARM Architecture and its versions, RS485 and GPIB buses

1 **2 Hours**

EXPERIMENT 1

Interface Switches and LEDs

2 **2 Hours**

EXPERIMENT 2

Interface Switches with the system

3 **4 Hours**

EXPERIMENT 3

Interface LCD and Display "Hello World"

4 **4 Hours**

EXPERIMENT 4

Interface 4*4 Matrix Keyboard

5 **4 Hours**

EXPERIMENT 5

Interface Stepper Motor

6 **2 Hours**

EXPERIMENT 6

Interface 7 Segment Display using I2C

7 **2 Hours**

EXPERIMENT 7

Interfacing Analog to Digital Converter

8 **2 Hours**

EXPERIMENT 8

Interface Digital to Analog Converter

9 **4 Hours**

EXPERIMENT 9

Implementing Real Time Clock

10 **4 Hours**

EXPERIMENT 10

Implementing Relay Control

Total: 60 Hours

Reference(s)

1. Raj Kamal, "Embedded Systems Architecture Programming and Design", Second Edition,TMH, 2010.
2. Prasad.K.V.K.K, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005
3. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design",Morgan Kaufman Publishers, First Indian Reprint, 2001
4. Steve Furber, "ARM System on Chip Architecture" Addison- Wesley Professional Second Edition, Aug 2000
5. Andrew N.Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaufmann Publishers, Elsevier, 2004.
6. MicroC/OS-II: The Real-Time Kernel by Jean J. Labrosse

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					4					8												8		22
2		2			1									6			6								15
3	4				4						5			5								4			22
4	2					4				5			5				2	2							20
5	2				2	2					7				4		4								21
																								Total	100

Assessment Questions

Remember

1. What is Microcontroller?
2. What is the difference between the Microprocessors and Microcontrollers?
3. What is mean by loop time subroutine in PIC microcontroller?
4. State the application of PORTB change interrupt. How to enable this interrupt.
5. List the features of CAN bus.
6. A 10 bit A/D converter with VRL=1V and VRH=4V.Find the corresponding voltage values for the A/D conversion results of 25, 80, 240.
7. What is bootstrap loader?
8. Reproduce the SRAM memory map diagram.
9. With suitable examples, explain branch instructions, loop primitive instructions and boolean logic instructions of HCS12 microcontroller.
10. What is the role of INDF in indirect addressing mode?

Understand

1. With suitable diagrams, explain the functions of clock and reset generation block of HCS12 microcontroller.
2. How do you enable other interrupts when the HCS12 is executing an interrupt service routine?
3. The transducer output voltage ranges from 0V to 400mV.Choose the appropriate values for R1 and R2 to scale this range to 0~5V.
4. Explain the functional block diagram and pin diagram of MSP430 microcontroller.
5. Differentiate little Indian ordering and big Indian ordering.
6. Mention the use of INDF in indirect addressing mode.
7. State the difference between timer0 and timer1of PIC microcontroller.

8. Predict the hardware architecture type of PIC microcontroller and explain it and also the pipelining concept of PIC.
9. Discuss the program memory considerations of PIC microcontroller.
10. Extrapolate the functioning of the ATD module in S12X microcontroller with neat diagram.
11. Difference between SPI and I2C.

Apply

1. Write an instruction sequence to perform the operation equivalent to those performed by the following high level language statements. I = 11; J = 33; K = I + J – 5;Assume that the variables I, J, K are located at $1000, $1005 and $1010 respectively.
2. Write an instruction sequence to perform 32-bit unsigned multiplication using S12X instruction sets.
3. Apply the concept of PWM mode in PIC microcontroller to operate a stepper motor.
4. Relate the concept of sleep mode with timer1 in PIC microcontroller and explain about it.
5. List the three real time example to illustrate the Analog to digital conversion process.
6. Write a program to add two 16-bit numbers that are stored at $1000 - $1001 and $1002 - $1003 and store the sum at $1010 - $1011.
7. Give an instruction to configure the MODRR register to achieve the following port routing : 1. CAN0: use pins PM1 and PM0, 2. CAN1: use pins PM3 and PM2, 3. CAN2: disabled, 4. CAN4: disabled, 5. I2C : use PJ7 and PJ6, 6.SPI0: use pins PS7~PS4,7. SPI1: use pins PP3~PP0.

Analyse

1. Classify the instruction sets of PIC microcontroller and explain the i) arithmetic operation and ii) bitwise operation instructions with examples.
2. Compare the two addressing modes of PIC microcontroller with neat sketch and explain them.
3. Outline the CPU registers of PIC microcontroller and explain each one of them.
4. Explain Timer2 scaler initialization? Give the generalized formula for initialize Timer2.
5. What is meant by SLEEP mode in PIC16CXX? How Timer 1 is related to SLEEP mode?
6. What are the values of accumulator A and the C flag after executing the asla instruction assuming that originally A contains $95 and the C flag is 1?
7. There is a system that uses a 4-MHZ crystal oscillator to derive a 24-MHZ E-clock. Write a subroutine to perform the required configuration.
8. What are the three issues that need to be considered when adding external memory?

Evaluate

1. Find the value for the CCP1CON register in compare mode if we want to toggle the CCP pin upon match?
2. Judge whether compare or capture mode in PIC microcontroller is used to get the time period of the input pulse and justify your answer in detail.
3. Select the appropriate mode from the 3 modes of timer in PIC microcontroller to generate a square wave and explain its operation.
4. State the application of PORTB change interrupt. How to enable this interrupt?
5. A device which is having a characteristic of changing its resistance when the intensity of incident light varies is connected to channel number 4.Configure the registers of S12X controller to sense the variation in resistance and display the result digitally.

Create

1. Design, implementation, and demonstration of a model of a conveyor control system. It includes frequency measurement and motor control using PWM technique.

15EC504 CONTROL SYSTEMS 3 2 0 4

Course Objectives

- To gain knowledge on system representation and time response of a system.
- To understand the various time domain and frequency domain tools tools for analysis and design of linear control systems
- To study the methods to analyze the stability of systems from transfer function forms.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Determine the transfer function of systems
2. Analyze the time domain response of the system
3. Analyze the major issues that affect the stability of the system
4. Analyze the frequency domain response of the system
5. Design and Analyze the state variable and state space

Articulation Matrix

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

UNIT I **9 Hours**

SYSTEM REPRESENTATION

Open loop and closed loop systems-Terminology and basic structure- Elements of closed loop systems - Transfer function concept- Modelling of mechanical systems, Block diagram reduction techniques - Signal flow graphs - Mason's gain formula.

UNIT II **9 Hours**

TIME RESPONSE ANALYSIS

Standard test signals - Time response of First and Second order system for step input and ramp input- time response specifications - Type of systems - Steady state error constants, generalized error series - Basics of PD, PI, PID Controller

UNIT III **9 Hours**

STABILITY OF SYSTEMS

Stability and the roots of characteristic equation- Routh Hurwitz criterion of stability- Range for parameters -conditionally stable systems- Root locus technique -Rules for root locus plot- Stability analysis.

UNIT IV **9 Hours**

FREQUENCY RESPONSE ANALYSIS

Frequency domain specifications - Peak resonance, resonant frequency, bandwidth and cut-off rate - Polar plot -Bode plot -Gain plot, phase plot, gain margin and phase margin- Nyquist plots - Stability in frequency domain -Nyquist criterion.

UNIT V **9 Hours**

STATE VARIABLE ANALYSIS

Introduction to state space analysis- State model of linear systems-State phase representation using physical variables, phase variable and canonical variables - State transition matrix, Concept of Controllability and Observability, State space representation of discrete time system

FOR FURTHER READING

Transfer function of DC generator, DC motor, Gear trains, PD, PI, PID Compensation techniques, Dominant pole of control system, Characteristic equation- Bounded input Bounded output stability, Application of Routh-stability criterion to linear feedback, All-Pass and Minimum-Phase Systems

Total: 75 Hours

Reference(s)

1. Ogata K Modern Control Engineering, Tata McGraw Hill, 2005.
2. D.RoyChoudhury, Modern Control Engineering, PHI, 2006.
3. M.N.Bandyapadhyay, Control Engineering, PHI, 2003.
4. I.J.Nagrath, and M.Gopal, Control Engineering, New Age International, 2007.

Assessment Pattern

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

Assessment Questions

Remember

1. Define damping ratio.
2. Define the transfer function of a system.
3. State the rule for shifting the take off point ahead of the block.
4. State the rule for shifting the summing point after the block.
5. Define Mason's gain formula.
6. Define settling time of a second order system with relevant equation.
7. Define rise time and delay time of a second order system with relevant equation.
8. Define bounded input bounded output stability.
9. State Routh stability criterion.
10. State how the gain adjustments are made in Nichol's chart.

Understand

1. Sketch the block diagram and signal flow graph for field controlled DC motor.
2. Derive the transfer function of hydraulic systems.
3. Derive the response of under damped and over damped second order system with unit ramp input.
4. Derive the response of critically damped second order system with unit step input.
5. Derive the expressions for time domain specifications of second order under damped system with unit step input.
6. Differentiate between the various types of controllers.
7. Illustrate the step by step procedure to obtain the bode plot.
8. Examine the effect of adding zeros to G(s)H(s) on the root locus.
9. Examine the technique to obtain the transfer function of a system from its state diagram.
10. Enumerate the methods to improve the phase margin and gain margin of any system.

Apply

1. Determine the type and order of the system for G(s)H(s) = K(s+3) / s^2 (s+2)(s+5)
2. A unity feedback control system has an open loop transfer function, G(s)= 25/ s(s+5). Find the rise time, percentage overshoot, peak time and settling time for a step input of 12 units.
3. Determine the time domain specifications for the damping ratio = 0.5 and natural frequency = 8 rad/sec.
4. Determine the range of values of K for the system to be stable s^4 + 20 s^3 + 15 s^2 +2s + K=0.
5. Sketch the bode plot of the transfer function and determine the system gain K for the gain cross over frequency to be 8 rad/sec. G(s) = Ks^2 / (1+.5s)(2+5s).
6. Construct the Routh array and determine the stability of the system whose characteristic equation s^7 + 3s^6 + 5s^4 + s^3 + 2s^2 + s =0. Also determine the number of roots lying on right half of s-plane.
7. Sketch the root locus for the unity feedback system whose open loop transfer function is G(s)H(s) = K/ s(s+5)(s^2 + 3s + 10).
8. Sketch the polar plot of the transfer function and determine whether the plot crosses the real axis. If so, determine the frequency at which the plot cross the real axis and and corresponding magnitude G(jω). Determine the phase margin and gain margin for the same. G(s) = 1 / s (1+s)(1+5s).
9. Determine the frequency response indices for a second order system yielding Mp= 0.2 and tp = 0.3 ms.
10. Determine the value of k so that the gain margin is 6 dB and the phase margin is 40 for an open loop system G(s) = K / s(1+0.1s)(1+s).

Analyse

1. Compare the open loop system and closed loop system
2. Differentiate bode plot from polar plot.
3. Give the step by step procedure of determining transfer function using signal flow graph
4. Discuss the reason as of why derivative controller is not used in control system.

5. Contrast type 0 and type 1 system.

Evaluate

1. For the given signal flow graph determine the transfer function.
2. Compare time domain and frequency domain specifications.
3. Compare P, PI and PID controllers.
4. Examine the classification of control system depending on the value of damping.
5. With reference to time response of a control system, define peak time.

Create

1. Construct the PID controller.
2. Draw one mechanical translational system and obtain the transfer function using signal flow graph.

15EC507 DIGITAL SIGNAL PROCESSING LABORATORY

0 0 2 1

Course Objectives

- To make the students understand the behavior and response of the filter using different methods.
- To study the output response of the system, sampling rate conversion and FFT spectrum.
- To know the generation of the signals and arithmetic operations using TMS320C5X DSP Processor.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Design of digital filter and Generation of various signals, Analysis of signal and system properties
2. Computation of circular and linear convolution
3. Determine the frequency transformation and Analysis of sampling rate
4. Design of digital filters
5. Analyze the power spectral density of the system.

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

1 **2 Hours**

EXPERIMENT 1

Generation of Signals - Ramp, sine, step, exponential and impulse.

2 **4 Hours**

EXPERIMENT 2

Properties of Discrete time Systems-Linearity, Stability, Causality and Time variance

3 **2 Hours**

EXPERIMENT 3

Sampling of an audio signal with different sampling rate and reconstruct the sampled signal

4 **2 Hours**

EXPERIMENT 4

Computation of DFT of a signal using basic equation and FFT and power spectrum estimation using DFT

5 **6 Hours**

EXPERIMENT 5

Design and Simulation of IIR and FIR filters.

6 **2 Hours**

EXPERIMENT 6

Analysis of finite word length effects

7 **4 Hours**

EXPERIMENT 7

Multirate signal processing-Down sampling , Up sampling , Decimation and Interpolation

8 **4 Hours**

EXPERIMENT 8

Convolution and Correlation of signals

9 **2 Hours**

EXPERIMENT 9

Spectrum Analysis of speech signals

10 **2 Hours**

EXPERIMENT 10

Noise reduction in speech signal

Total: 30 Hours

Reference(s)

1. Alan V Oppenheim, Ronald W Schafer, John R Beck, Discrete Time Signal Processing, PHI, 2000, Avtarsingh, S.Srinivasan, DSP Implementation using DSP microprocessor with Examples from TMS32C54XX -Thamson / Brooks cole Publishers, 2003
2. S.Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill / TMH, 2000
3. S.K.Mitra, Digital Signal Processing- A Computer based approach, Tata McGraw-Hill, 2003, New Delhi.

15EC508 TRANSMISSION LINES AND ANTENNAS LABORATORY

0 0 2 1

Course Objectives

- To study various antennas, arrays and radiation patterns of antennas
- To learn the fundamental mechanism behind working of antennas
- To understand various techniques involved in various antenna parameter Measurements and the propagation of radio waves

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.

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.

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 ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Simulate the impedance matching networks and transmission lines
2. Simulate the radiation fields of Half wave dipole and Quarter wave Monopole
3. Simulate the radiation factors of array antennas
4. Measure the Radiation Pattern of Horn Antenna and Parabolic Antenna
5. Design and Simulate the Microstrip Patch and slot Antennas

Articulation Matrix

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

1 **4 Hours**

EXPERIMENT 1

Simulation of Impedance matching networks

2 **4 Hours**

EXPERIMENT 2

Simulation of transmission lines

3 **2 Hours**

EXPERIMENT 3

Simulation of radiated fields of Half wave dipole and Quarter wave Monopole

4 **2 Hours**

EXPERIMENT 4

Simulation of array factor of Linear array

5 **4 Hours**

EXPERIMENT 5

Simulation of array factor of Broadside, Endfire arrays

6 **2 Hours**

EXPERIMENT 6

Simulation of array factor of Binomial arrays

7 **2 Hours**

EXPERIMENT 7

Simulation of array factor of Dolph-Tschebyscheff arrays

8 **2 Hours**

EXPERIMENT 8

Measurement of Radiation Pattern of Horn Antenna and Parabolic Antenna

9 **4 Hours**

EXPERIMENT 9

Design and Simulation of Microstrip Patch Antenna

10 **4 Hours**

EXPERIMENT 10

Design and Simulation of Microstrip slot Antenna

Total: 30 Hours

Reference(s)

1. Constantine A.Balanis , Antenna Theory , John Wiley, 2005
2. K.D.Prasad., Antennas and wave propagation, SathyaPraksham, 2001
3. John.D.Kraus and Ronalatory Marhefka, Antennas, Tata McGraw-Hill, 2002

15EC509 TECHNICAL SERMINAR I **0 0 2 1**

Course Objectives

- Acquire knowledge about the current technology
- Develop the communication and presentation skills
- Enhance the intellectual discovery and unravel the complexities of thought

Programme Outcomes (POs)

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

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

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

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

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

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

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

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple fields
2. Improve the technical presentation and communication skills.

3. Understand the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds
4. Interact and share their technical knowledge to enhance the leadership skills.
5. Prepare report and present oral demonstrations.

Articulation Matrix

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

Total: 30 Hours

15EC510 MINI PROJECT III 0 0 2 1

Course Objectives

- Speculate the problem identifying ability
- Improve the analyzing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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 ones 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. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

0 0 2 0

15GE511 LIFE SKILLS: APTITUDE I

Course Objectives

- To expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Distinguish the pattern of coding and decoding.
2. Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions
3. Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors
4. Calculate the percentages and averages

Articulation Matrix

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

1 **3 Hours**

CODING AND DECODING

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

2 **3 Hours**

SEQUENCE AND SERIES

Introduction - Sequences of real numbers - Number and Alphabet series - Description of Number and Alphabet series - Analogy - Odd man out- Power series

3 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid

4 **3 Hours**

DIRECTION

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

5 **3 Hours**

PROBLEM ON AGES

Introduction- basic concept - usage of percentage and averages- applications

6 **3 Hours**

ANALYTICAL REASONING

Introduction - basic concept - non verbal analytical reasoning - arrangements

7 **3 Hours**

BLOOD RELATION

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

8 **3 Hours**

BLOOD RELATION

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

9 **3 Hours**

VISUAL REASONING

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

10 **3 Hours**

SIMPLIFICATIONS

Introduction - Basic concepts - Arithmetic operations -Equation solving methods - Puzzles

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
4. Edgar Thorpe, Course In Mental Ability And Quantitative Aptitude For Competitive Examinations, Third Edition, Tata McGraw-Hill Publishing Company Ltd, 2013.
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

15GE701 ENGINEERING ECONOMICS 3 0 0 3

Course Objectives

- To introduce the concepts of micro, macro economic systems and business decisions in organizations.
- To acquire knowledge on laws of demand & supply and methods of forecasting the demand
- To emphasis the systematic evaluation of the costs, breakeven point for return on economics and diseconomies
- To acquaint in pricing methods, payback and competition in modern market structure
- To obtain knowledge on macro economics, various taxes and financial accounting procedures

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Course Outcomes (COs)

1. Explain the micro economic environment for creating a favourable business environment.
2. Make use of the major concepts and techniques of engineering economic analysis in real time applications.
3. Compare the cost of multiple projects by using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
4. Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
5. Examine and evaluate the issues in macro-economic analysis.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier - Opportunity Cost - Objective of Organizations - Kinds of Organization.

UNIT II **9 Hours**

DEMAND AND SUPPLY

Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply - Elasticity of Demand - Demand Forecasting Methods - Indifference curve.

UNIT III **9 Hours**

PRODUCTION AND COST

Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-economies of scale - Break Even point.

UNIT IV **9 Hours**

MARKET STRUCTURE

Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methods of Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment - Payback Period.

UNIT V **9 Hours**

INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING

National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct and Indirect Taxes - Fiscal and monetary policies.

FOR FURTHER READING

Nature and characteristics of Indian Economy - Role and functions of Central bank - LPG - GATT - WTO.

Total: 45 Hours

Reference(s)

1. A Ramachandra Aryasri and V V Ramana Murthy, Engineering Economics and Financial Accounting, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. V L Samuel Paul and G S Gupta,Managerial Economics Concepts and Cases, Tata McGraw Hill Publishing Company Limited, New Delhi, 1981.
3. R Kesavan, C Elanchezhian and T Sunder Selwyn, Engineering Economics and Financial Accounting, Laxmi Publication (P) Ltd, New Delhi, 2005.
4. S N Maheswari, Financial and Management Accounting, Sultan Chand
5. V L Samuel Paul and G S Gupta, Managerial Economics-Concepts and Cases

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2					2					8			6											18
2		2					2			8					6				4						22
3			2			2				8								4							16
4	2						2		8						6				4						22
5		2				2				8				6				4							22
																								Total	100

Assessment Questions

Remember

1. Define Economics
2. What is opportunity cost?
3. List the types of Demand.
4. State the law of Demand.
5. Define Elasticity of Demand.
6. State the different degrees of elasticity of Demand?
7. List the factors determining Elasticity of Demand?
8. State the Law Of Diminishing Marginal Utility.
9. Define Replacement Cost and Historic Cost
10. Define Monopoly.
11. Define Oligopoly
12. Name the two types of Oligopoly.
13. List the objectives of Pricing?
14. Define Accounting
15. Define inflation

Understand

1. Explain the nature and scope of Economics.
2. List and explain the focus areas of Managerial economics.
3. Give reasons why mangers aim to maximize sales even at the cost of a lower profit.
4. Explain the nature of Demand.
5. What are the assumptions made when talking about the Law of Diminishing Marginal Utility?
6. Explain the characteristics of the Indifference Curve with examples
7. Can Demand Forecasting principles be applied to Services? Substantiate your answer with an example
8. What are the characteristic features of an oligopoly industry?
9. What causes Oligopoly?
10. Explain the types and features of Cost Based Pricing.

11. Explain the types and features of Demand Based Pricing.
12. Under what conditions does a company go in for Cross Subsidization pricing?
13. What is the role of the Central bank in controlling inflation?

Apply

1. Explain decisions based on the degree of certainty of the outcome with examples.
2. Give examples of products falling under the various kinds of competition, and the reasons they are able to survive in the market.
3. Give six examples of products that fall under Monopolistic Competitive pricing.
4. Give six examples of products that fall under Oligopolistic pricing
5. Pick any six Consumer Items and based on your knowledge of the markets, explain the pricing method that you think is most likely to have been followed for each of these items.

Analyse

1. Differentiate between Macro and Micro economics
2. Differentiate between Extension and Increase in Demand.
3. Distinguish between Cost and Price
4. Compare the merits and demerits of the Deductive Method and the Inductive Method of Investigation
5. The per-capita income of farmers in the country has to be raised by 20% this year to prevent their migration to cities. Discuss this statement from the point of view of Positive and Normative Economics.
6. Decision making improves with age and experience- Discuss.
7. Do a survey of the automotive (only cars) industry and analyze the reasons and timing for discounts offered from the point of view of elasticity of demand
8. How would you modify a sealed bid pricing system to take care of different technical approaches by different bidders for a project for which bids are called for, given that the cost varies depending on the technical approach?

Create

1. Create a matrix consolidating the definitions of the word ï¿½??Economics as defined by the leading Economists in the prescribed textbook. Using this define economics the way you understand it, in less than 50 words.
2. Study the price of a commodity over a period of one year and explain the possible reasons for the fluctuations from an economist‘s point of view
3. You are in a job which is paying you adequately. You are called for an interview for a job that double your salary. Unfortunately you miss the only train that will take you in time for the interview. How will you justify the cost of taking a flight considering the cost concepts you have learnt?
4. Due to cancellation of an export order, you are stuck with a huge stock of jeans of international quality. Device a pricing strategy for disposing this stock without incurring a loss, considering that it is a very competitive market.

15EC602 DIGITAL COMMUNICATION 3 0 0 3

Course Objectives

- To study the basics of different Digital communication techniques
- To know the concept and details of error control coding techniques
- To enumerate the idea of spread spectrum modulation

Programme Outcomes (POs)

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

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

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

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

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

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze Pulse Code Modulation schemes for digitizing analog signals and apply digital multiplexing concept for different applications
2. Design a system that transmits baseband signals with minimum distortion and analyze the level of ISI using eye pattern
3. Analyze the performance of different digital modulation /demodulation techniques
4. Evaluate the efficiency of source coding for data compression and perform channel coding for error detection/controlling of digital data transmission
5. Analyze spread spectrum modulation techniques to eradicate interference in wireless communication

Articulation Matrix

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

UNIT I **9 Hours**

PULSE MODULATION

Sampling process - Quantization -PCM -TDM - Differential pulse code modulation - Adaptive differential pulse code modulation - Delta modulation - Adpative Delta modulation.

UNIT II **9 Hours**

BASEBAND PULSE TRANSMISSION

Matched Filter- Error Rate due to noise -Intersymbol Interference- Nyquist's criterion for Distortion less Base band Binary Transmission- Correlative level coding-Baseband M-ary PAM transmission - Eye Patterns.

UNIT III **9 Hours**

PASSBAND DATA TRANSMISSION

Introduction -Pass band Transmission model- Generation, Detection, Signal space diagram, bit error probability and Power spectra of BPSK, QPSK, QAM and Non cohorent BFSK,DFSK schemes - Comparison of Digital modulation systems.

UNIT IV **9 Hours**

INFORMATION THEORY AND CODING

Entropy, Source coding theorem, Prefix code - Huffman Coding, channel capacity, channel coding theorem, Information capacity theorem, Linear block codes - Cyclic codes - Convolutional codes-Decoding of convolutional codes-Viterbi Algorithm.

UNIT V **9 Hours**

SPREAD SPECTRUM MODULATION

Pseudo- noise sequences-a notion of spread spectrum- Direct sequence spread spectrum with coherent binary phase shift keying- Frequency hop spread spectrum and Applications.

FOR FURTHER READING

Comparison of PCM and DM, MPEG audio coding standard - Application of coherent reception in PSK and FSK- GSM - Multiple access techniques used in mobile wireless communications.

Total: 45 Hours

Reference(s)

1. Simon Haykins, Communication Systems John Wiley, 2001
2. Simon Haykins, Digital Communication John Wiley, 2001.
3. Sam K.Shanmugam Analog & Digital Communication John Wiley, 2007.
4. John G.Proakis, Digital Communication McGraw Hill, 1995.
5. Taub&Schilling , Principles of Digital Communication, Tata McGraw-Hill, 2003.
6. Bernard Sklar, Digital Communication, Pearson Education, 2000.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				5	5				2														16
2		2				6								6											14
3	2						5			10								5							22
4	2					4					10			10											26
5		4				10				8															22
																								Total	100

Assessment Questions

Remember

1. State Channel Capacity theorem.
2. Define prefix codes
3. State the balance property of maximum length sequence.
4. Define entropy.
5. Draw the structure of a typical correlation receiver.
6. State the Nyquist's criterion for distortionless baseband data transmission.
7. State the importance of Convolutional Codes
8. Define Pseudo noise sequence
9. State the importance of spread spectrum modultion.
10. Define cyclic codes.

Understand

1. Draw the binary on-off signaling waveform for a binary sequence 11011010.
2. List the limitations of PCM.
3. Distinguish between bit versus symbol error probabilities.
4. Generate a maximal length sequence of period 7 using 3-stage feedback shift register.
5. Find the differentially encoded sequence when the binary sequence 1100100 is applied to the DPSK transmitter. Compare the power spectra of binary phase shift keying and frequency shift keying modulation schemes.
6. Consider the (5,1) repetition code. Construct the generator and parity check matrices.
7. Find the transfer function of a rate ½, constraint length 3, convolutional Encoder with generator sequences g(1) =(1 0 1) , g(2) =(1 1 0) and g(3) = (1 1 1). Construct the trellis diagram of the Convolution encoder for message length of 4.
8. Prove that the output signal of a matched filter is proportional to the shifted version of the autocorrelation function of the input signal.
9. Illustrate the notion of spread spectrum.
10. Explain direct sequence spread sprectrum.

Apply

1. Calculate the capacity of a channel, which has a bandwidth of 3.4 kHz for a signal to noise ratio of 30dB.
2. Consider a discrete memoryless source with source alphabets S=[S1,S2,S3,S4] with probabilities P=[.25 .25 .25 .25].Calculate the entropy of second order extension of the source S.
3. Find the syndrome using syndrome calculator for (7,4) cyclic hamming code of a given polynomial g(D)1 D D3 assuming that the received code word is 0111001.
4. A PN Sequence is generated using a Feedback shift register of length m=4. The chip rate is 107 chips/sec. Find the PN Sequence period of the sequence.
5. The binary data stream 001101 is applied to the input of a duo binary system. Construct the duo binary coder output.
6. Compute the differential entropy of a random variable x, distributed over the interval [0,a].
7. A spread spectrum communication system has information bit duration T=4.095msec and PN Chip duration 1 sec. Compute the processing gain.
8. Determine the transmission bandwidth of the base band binary PAM system with raised cosine spectrum at the rate of 56Kbps. Assume that roll off factor 0.5.
9. Find the minimum value of n of a (n,k) linear block code with a minimum distance of three and message block size K=8.
10. Explain the direct sequence spread spectrum with coherent binary phase shift keying.
11. Derive an expression for the probability of error of M'ary PSK modulation scheme.

Analyse

1. Analyze the BER performance of the following binary modulation schemes. a. Binary Phase Shift keying b. Amplitude Shift Keying c. Frequency Shift Keying.

2. A Binary wave uses on – off signaling to transmit symbols 1 and 0. The symbol 1 is represented by a rectangular pulse of amplitude A and duration Tb sec. The additive noise at the receiver input is white and Gaussian with zero mean and Power spectral density / 2 O N .Assuming that symbols 1 and 0 occur with equal probability. Analyze the BER performance of this system.
3. Derive the expressions for Probability of error, Jamming Margin and Processing Gain of a Direct Sequence Spread Spectrum system.
4. Analyze the information capacity theorem.

Evaluate

1. A PCM system uses a uniform quantizer followed by a 8 bit binary encoder. The bit rate of the system is 64Mbps. What is the maximum message bandwidth for which the system operates satisfactorily?
2. The sinusoidal signal x(t) sin(2π (2000)t) is applied to a delta modulator and the sampling duration is 20ms. Calculate the minimum step size required to avoid the slope overload distortion.
3. A Discrete memoryless source has an alphabet of x=[x1 x2 x3 x4 x5 x6 x7] with the statistics P=[.35 .3 .2 .1 .04 .005 .005]. a. Compute the Huffman code and its average length. b. Compute the entropy of the source c. Evaluate the efficiency of the code.
4. Construct the modified duo binary coder output and corresponding Receiver output without a precoder.
5. Summarize the Viterbi algorithm.

Create

1. Derive a flowchart to show the steps involved in transmitting a digital signal to receiver.
2. Generalize the methods to increase the speed of digital communication.

15EC603 COMPUTER NETWORKS 2 0 2 3

Course Objectives

- To understand the concept of data communication and networking models
- To study the functions of OSI layered architecture and its protocols.
- To explore the routing, addressing and security aspects of computer networks
- To recognize the real time multimedia application in wired and wireless networks

Programme Outcomes (POs)

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

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

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

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

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

Course Outcomes (COs)

1. Compare OSI model with TCP/IP protocol suite and analyze error and flow control algorithms for communication between adjacent nodes in a network.
2. Analyze the performance of various LAN protocols.
3. Identify and apply the suitable routing protocols used in internet layer for the given network.
4. Analyze various protocols used for process to process delivery services and traffic reduction mechanisms.
5. Develop a client/server network using application protocols and analyze the capabilities of application layer utilities.

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			3	2									
4	1	2		3										
5	1	2	3											

UNIT I **6 Hours**

PHYSICAL/DATA LINK LAYER

Types of networks - Circuit Switching and Packet Switching OSI model-TCP/IP protocol suite-Transmission media- error control and flow control.

UNIT II **6 Hours**

LOCAL AREA NETWORK

Multiple Access Protocols - Ethernet- SONET-Optical fiber in CSMA/CD LAN-FDDI-CDMA LAN-Fiber-to the curb-FTH-ATM -802.11 Wireless LAN.

UNIT III **6 Hours**

IP AND NETWORKS LAYER

IPV4-ICMPv4-IGMP- Mobile IP - Next generation IP: IPV6, ICMP v6 - Routing Protocols: distance vector-link state, unicast routing:RIP,OSPF4- multicast routing:DVMRP-MOSPF

UNIT IV **6 Hours**

TRANSPORT LAYER

Transport Layer Services - Multiplexing and Demultiplexing - User Datagram Protocol (UDP) - Principles of Reliable Data Transfer - Transmission Control Protocol (TCP).Congestion Control.

UNIT V **6 Hours**

APPLICATION LAYER

WWW- HTTP- FTP- Telnet- Domain name space. Network security: Attacks, confidentiality: cipers, Digital signature, Authentication, Key management

FOR FURTHER READING

Multimedia Networking: Properties of audio/video- Streaming Stored Audio and Video Voice over IP-Case Study: VoIP with Skype

1 **6 Hours**

EXPERIMENT 1

Implementation of Ethernet LAN protocol for star, bus and ring topology

2 **2 Hours**

EXPERIMENT 2

Simulation and Performance comparison of wireless LAN protocols

3 **2 Hours**

EXPERIMENT 3

Implementation of Link state and distance vector routing algorithm

4 **4 Hours**

EXPERIMENT 4

Testing the functionality of IPv6 addressing, fragmentation and switch configuration

5 **4 Hours**

EXPERIMENT 5

Testing the functionality of IPSec for Transport mode and Tunneling mode

6 **2 Hours**

EXPERIMENT 6

Implementation of VOIP application with h323 and SIP protocol.

7 **4 Hours**

EXPERIMENT 7

Behavior analysis of the TCP variants (Tahoe, Reno, Lite, Newreno, Sack) in the presence of 0, 1, 2, 3and 4 packet drops.

8 **4 Hours**

EXPERIMENT 8

Check the performance of Queuing in wired network with bottleneck condition.

9 **2 Hours**

EXPERIMENT 9

Design and implementation of wireless networks in Adhoc and infrastructure model

Total: 60 Hours

Reference(s)

1. Behrouz Foruzan, Data communication and Networking, Tata McGraw-Hill, 2013,5th edition
2. William Stallings, Data and Computer Communication, PHI 2010
3. Larry L.Peterson&S.Peter Davie, Computer Networks, Harcourt, 2008
4. Andrew S.Tannenbaum, Computer Networks, PHI, 2010
5. James F.Kurose& Keith W.Ross, Computer Networking A Top-down Approach Featuring the Internet, PHI, 2007
6. M.N.Bandyopadhyay, Optical communication Networks,PHI,2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				2					8			4											18
2		2					2			8					6				4						22
3			2			2				8								4							16
4	2					2			8						6				4						22
5		2					2			8				6				4							22
																								Total	100

Assessment Questions

Remember

1. List three categories of multiple access protocols
2. List five nonproprietary Internet applications and the application-layer protocols that they use.
3. Explain how congestion avoidance can be achieved by TCP protocol?
4. Recognize the function of NIC.
5. Mention the advantages of dividing an Ethernet LAN wih a bridge.
6. Explain dropping and adding STS-1 frames in an add/drop umltiplexer.
7. Define SONET.
8. State the advantages of multicast routing protocols.
9. Define Telnet.
10. List the advantages of user datagram protocol.

Understand

1. Distinguish between a link and a channel in multiplexing.
2. Explain why collision is an issue in a random access protocol but not in controlled access or channelizing protocols.
3. How does an NNI differ from a UNI?
4. Why do OSPF messages propagate faster than RIP messages?
5. Compare interdomain and intradomain routing protocols.
6. Differentiate between message confidentiality and message integrity.
7. Why is there no need for CSMA/CD on a full-duplex Eternet LAN?
8. Compare a piconet and a scatternet.
9. How STS-9 multiplexed to create an STS-36?
10. Choose a congestion control technique for the LAN in your institution.
11. Explain why most of the addresses in class A are wasted?
12. Contrast two routing tables of DV and LSR.
13. How many bytes are empty in a RIP message that advertises N networks?
14. Why port address needs to be unique?

Apply

1. Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.
2. A sender sends a series of packets to the same destination using 5-bit sequence numbers. If the sequence number starts with 0, what is the sequence number after sending 100 packets?
3. In a CDMA/CD network with a data rate of 10 Mbps, the minimum frame size is found to be 512 bits for the correct operation of the collision detection process. What should be the minimum frame size if we increase the data rate to 100 Mbps? To 1 Gbps? To 10 Gbps?

4. Show in hexadecimal colon notation the IPv6 address a. Compatible to the IPv4 address 129.6.12.34 b. Mapped to the IPv4 address 129.6.12.34
5. Consider an e-commerce site that wants to keep a purchase record for each of its customers. Describe how this can be done with cookies.
6. Apply the following operations on the corresponding polynomials:
   a. (x1=x+1) + (X1+x+1)
7. Find the values of K and n in the Hamming code C(n,k) with d min = 3 to get a dataword of atleast 11 bits.
8. A pure ALOHA network transmits 200 bit frames on a channel of 200kbps. What is the requirement to make this frame collision - free?
9. A slotted ALOHA network transmits 200 bits frames using channel with a 200kbps bandwidth. Find the throghput if the sytem produces a. 1000 frames / sec b. 500frames/sec
10. Which one has more overhead, a bridge or a router? Explain your answer.
11. Find the data rate of an STS-3 signal
12. An organization is granted the block 16.0.0.0/8. The administrator wants to create 500 fixed length subnets.Find a. the subnet mask, b. Find the number of addresses in each subnet
13. Use the ping program to test your own computer.

Analyse

1. Compare and contrast byte-stuffing and bit-stuffing.
2. Prove that a receiving station can get the data sent by a specific sender if it multiplies the entire data on the channel by the sender's chip code and then divides it by the number of statio
3. Some people argue that we can consider the whole address space as one single block in which each range of addresses is a subblock to this single block. Elaborate on this idea. What happens to subnetting if we accept this concept?
4. How many bytes are empty in a RIP message that advertises N networks?
5. Compare Go Back N ARQ with selective Repeat ARQ
6. Compare CSMA and CSMA/CD MAC schemes.
7. Do we need a multiple access protocol when we use one CATV channel to access the Internet? why
8. Compare SONET layers with OSI layers
9. Compare TCP header and UDP header.

Evaluate

1. A system uses the Stop-and-Wait ARQ Protocol. If each packet carries 1000 bits of data, how long does it take to send 1 million bits of data if the distance between the sender and receiver is 5000 KIn and the propagation speed is 2 x 108 m? Ignore transmission, waiting, and processing delays. We assume no data or control frame is lost or damaged.
2. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer: a.Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why? b. Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?
3. Review the car-caravan analogy. Assume a propagation speed of 100 km/hour. a. Suppose the caravan travels 150 km, beginning in front of one tollbooth, passing through a second tollbooth, and finishing just after a third tollbooth. What is the end-to-end delay? b. Repeat (a), now assuming that there are eight cars in the caravan instead of ten.
4. Suppose an attacker knows that a target host uses SYN cookies. Can the attacker create half-open or fully open connections by simply sending an ACK packet to the target? Why or why not?

5. Prove that hash provide better message integrity than checksum.
6. Describe the procedure for medium access in wireless networks.
7. Find the chips for a network with using Walse table: a. Two stations b. Four stations
8. Comment the issues involved in using ATM technology in LANs.
9. Explain subnetting and Supernetting in with eaxmple.
10. Find out why there are two security protocols in IPV6.

Mask	network address	next hop	interface
/27	202.14.17.224	-	m1
/18	145.23.192.0	-	m0
Default	Default	130.56.12.4	m2

11. Design the topology of the network if above Table is the routing table for router R1.
12. Compare the UDP, TCP and SCTP with respect to flow control, error control and congestion control.

15EC604 VLSI SYSTEM DESIGN 3 0 0 3

Course Objectives

- To understand the ASIC and FPGA based design fundamentals using Verilog HDL
- To give basic knowledge of Programmable devices and EDA tools
- To study the fundamental concepts about Testing of VLSI circuits.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Design digital logics using Verilog HDL and verify using test bench
2. Design digital systems using Verilog HDL
3. Analyze the ASIC implementation process
4. Analyze the programmable IC implementation process
5. Analyze the faults in digital logic by using various testing methods

Articulation Matrix

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

UNIT I **11 Hours**

VERILOG HDL AND TEST BENCHES

Importance of HDL, Design Methodologies, Basic Concepts - Lexical Conventions - Data Types - Verilog Operators - Modules and Ports - Gate Level, Dataflow, Behavioural - Verilog Test Benches

UNIT II **8 Hours**

ADVANCED VERILOG HDL AND SYSTEM DESIGN

Switch Level Modeling - User Defined Primitives (UDP) - Timing and Delays - ALU - Barrel Shifter - Random Number Generator - Traffic Light Controller - Vending Machine Controller - Single Port RAM Design

UNIT III **9 Hours**

ASIC DESIGN

ASIC Design Flow - Types of ASICs - ASIC Design EDA tools - Analysis - DC, Transient, AC and Parametric Sweep Analysis - Design Synthesis - Floor Plan, Constructive & Iterative Partition and Placement Algorithm - Lee Maze Routing Algorithm - Physical Verification

UNIT IV **9 Hours**

PROGRAMMABLE ASIC

PROM, PLA, PAL ,CPLD Programmable IC Technologies - Introduction to FPGA - FPGA Implementation Process -FPGA EDA Tools - FPGA Internal Architectures - Actel ACT1 -Shannon's expansion theorem - Function generators - Xilinx XC3000 - Programmable Interconnections

UNIT V **8 Hours**

TESTING OF VLSI CIRCUITS

General Concepts - Faults in Digital Circuits - Fault Detection using Path Sensitization and Boolean Difference - Fault Simulation -Design For Testability (DFT) - Adhoc Design - Boundary Scan Test - Built In Self Test (BIST) - BILBO -LOCST- STUMPS - Signature Analyzer

FOR FURTHER READING

Bidirectional Shift Register - Comparisons between PLDs CPLD and FPGAs - Interfacing Matlab Simulink with Xilinx ISE - DSP Application using Xilinx System Generator

Total: 45 Hours

Reference(s)

1. Ming-Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, 2012.
2. M.J.S .Smith, "Application Specific Integrated Circuits, Pearson Education Inc., 2006.

3. Samir Palnitkar, Verilog HDL, Pearson Education, 2nd Edition, 2004.
4. P.K.Lala, Digital Circuit Testing and Testability, Academic Press, 1997
5. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002.
6. M.Abramovici, M.A.Breuer and A.D.Friedman, Digital Systems and Testable Design, Jaico Publishing House, 2004.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1					2	8			8												8				26
2						2				8											8				18
3	2				2	8								8											20
4		8				2	8						2												20
5		2								6				2			6								16
																								Total	100

Assessment Questions

Remember

1. List out the various EDA tools.
2. State Moore’s Law.
3. What are all the types of programmable logic devices?
4. Write short notes on design entry and RTL.
5. Draw the Flowchart for ASIC Design Flow.
6. What is Synthesis?
7. Draw the flow chart for physical design flow.
8. What do you meant by timing analysis?
9. List the various operators in Verilog HDL and explain it briefly.
10. Explain about the various types of Loop Statement in Verilog HDL with example.
11. Define Fault Simulation.
12. List the types of Fault Model.
13. State the various principles of Ad Hoc testing with example.
14. List the various architectures of BIST.
15. Define Signature Analysis.

Understand

1. Draw the structure of CPLD
2. Explain in detail of CPLD architecture and its components.
3. Differentiate ASIC and FPGA.
4. List ant four ASIC EDA tool.
5. Briefly explain about the evolution of FPGA from PLD’s.
6. How many inputs and outputs are available in Xilinx 5200 CLB.
7. Explain briefly about various data types in Verilog.
8. What are the advantages of behavioral modeling?
9. Compare Initial versus always statement.
10. Difference between Stuck at 0 fault and Struck at 1 fault.
11. With neat Sketch explain the BILBO architectures involved in VLSI Testing.

Apply

1. List advantage and disadvantage of CPLD over FPGA
2. Write the steps to be followed in Modelsim in order to perform simulation of digital circuit.
3. Draw the Flowchart for RTL to Netlist Conversion.

4. Draw the block diagram of VLSI place and route.
5. Perform Right and Left Shift Operator for x=4'b1101.
6. Perform Arithmetic operation for a = 4'b0011; b = 4'b0100.
7. Perform Bitwise AND operation for A= 101010 , B= 011011.
8. Write verilog code for D flip flop.

Analyse

1. Compare PLA and PAL
2. Explain in detail about the device which has programmable AND plane and fixed OR plane.
3. Compare Front End and Back End VLSI.
4. List the various standards support by Modelsim.
5. Ways to Providing Stimulus to the Design.
6. Write down steps in design implementation.
7. Give 10 commonly used Verilog keywords.
8. What is the difference between posedge and negedge?
9. What is the difference between wire and reg?
10. Compare VHDL and Verilog HDL.
11. Differentiate Logical, Bitwise and Reduction operators
12. What is the difference between = = and = = =?
13. Compare different types of modeling in verilog.
14. What do you meant by fault coverage?
15. Compare Control Points and Observation Points.
16. Compare Dynamic versus Static Timing Analysis.

Evaluate

1. Compare PAL,PLA and PROM.
2. Discuss the various applications of FPGA.
3. Compare FPGA with other processor.
4. Compare Xilinx 3000,Xilinx 4000 and Xilinx 5200.
5. Compare Structural, Dataflow and Behavioral Modeling with example.

Create

1. Implement the following equation in ROM and PLA architecture
   F = AB + A'BC', G = A'B'C + C', H = AB'C' + ABC' + A'B'C
2. Write a code multiplier. Explain in detail about steps involved in implement the code in Xilinx ISE.
3. Write a verilog code for 4:1 Mux
4. Write a verilog code for cmos inverter in switch level modeling.
5. Write the Verilog HDL Code for a full Adder using Structural, Dataflow and BehavioralnModeling.
6. Draw a FSM for the following Transition table also writes Verilog HDL code.

Source state	Destination state	Input	Output
A	B	1	1
B	C	1	0
C	D	1	1
D	A	1	0
D	D	0	0
C	C	0	1
B	B	0	0
A	A	0	1

7. Design a vending Machine controller using Verilog.

15EC607 DIGITAL COMMUNICATION LABORATORY

0 0 2 1

Course Objectives

- To understand the fundamental communication system parameters such as bandwidth, power, signal to quantization noise ratio and data rate
- To learn the digital modulation techniques (QPSK and QAM) and their detection
- To know the concept and details of source coding and error control coding 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.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Analyze the characteristics of pulse shaping circuits in digital communication
2. Design and analyze the performance of digital modulation and demodulation schemes
3. Design and analyze the performance of linear and non-linear equalizer techniques
4. Design of error control coding techniques in digital transmission
5. Analyze the characteristics of pulse shaping circuits in digital communication

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Concept of Pulse Shaping to improve spectral efficiency using SDR Kit

2 **4 Hours**

EXPERIMENT 2

Generation, Reception, Timing and Clock Recovery and Constellation of QPSK using SDR Kit

3 **4 Hours**

EXPERIMENT 3

Generation, Reception, Timing and Clock Recovery and Constellation of 16-QAM using SDR Kit

4 **4 Hours**

EXPERIMENT 4

BER performance of BPSK/QPSK in Rayleigh fading Multipath channel using LMS and RLS Linear Equalizer

5 **4 Hours**

EXPERIMENT 5

BER performance of BPSK/QPSK in Multipath channel using Linear Decision Feedback Equalizer

6 **4 Hours**

EXPERIMENT 6

Simulation of Convolution Coding and Viterbi Decoding

7 **4 Hours**

EXPERIMENT 7

Design of Block interleaver for Reed Solomon Code

8 **4 Hours**

EXPERIMENT 8

Simulation of Turbo Encoding-Decoding system.

Total: 30 Hours

Reference(s)

1. Simon Haykins, Digital Communication John Wiley, 2001
2. John G.Proakis, Digital Communication McGraw Hill, 1995
3. Taub& Schilling , Principles of Digital Communication, Tata McGraw-Hill, 2003
4. Bernard Sklar, Digital Communication, Pearson Education,2000

15EC608 VLSI SYSTEM DESIGN LABORATORY 0 0 2 1

Course Objectives

- To understand HDL programming and its implementation in FPGA and ASIC Technology
- To study the digital circuits in System generator and IP core generator
- To sketch the layout using ASIC EDA tools

Programme Outcomes (POs)
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.
Course Outcomes (COs)

1. Design and simulate digital logics using Verilog HDL
2. Import the logic modules into FPGA Boards
3. Synthesize the Digital Logic using ASIC EDA tools
4. Draw the Layout using ASIC EDA Tool
5. Interface the FPGA and Processor for SoC Design

Articulation Matrix

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

1 **4 Hours**

EXPERIMENT 1
Model a Random Access Memory (RAM) using IP Core Generator

2 **4 Hours**

EXPERIMENT 2
Simulate the following Digital Circuits
a.Magnitude Comparator
b.Random Number Generator

3 **4 Hours**

EXPERIMENT 3
Implement the following Digital Circuits on FPGA
a.Ripple Carry Adder
b.ALU

4 **4 Hours**

EXPERIMENT 4

Implement a MAC Unit using System Generator

5 **4 Hours**

EXPERIMENT 5

Synthesize (90nm or 180nm) the following digital circuits and evaluate its area, power and delay using ASIC EDA tool

a.Adder-Subtractor

b.Parallel Multiplier

6 **5 Hours**

EXPERIMENT 6

Design, Simulate and Generate the GDSII/CIF File for the following using ASIC EDA Tool

a.CMOS inverter

b.CMOS NAND

c.CMOS NOR

7 **5 Hours**

EXPERIMENT 7

Construct a Simple System on Chip (SoC) Design using FPGA SoC Development Board

Total: 30 Hours

Reference(s)

1. Ming-Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, 2012.
2. M.J.S .Smith, "Application Specific Integrated Circuits, Pearson Education Inc., 2006.
3. P.K.Lala, Digital Circuit Testing and Testability, Academic Press, 1997.
4. M.Abramovici, M.A.Breuer and A.D.Friedman, Digital Systems and Testable Design, Jaico Publishing House, 2004.
5. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002

15EC609 TECHNICAL SEMINAR II 0 0 2 1

Course Objectives

- Acquire knowledge about the current technology
- Develop the communication and presentation skills
- Enhance the intellectual discovery and unravel the complexities of thought

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple field.
2. Improve the technical presentation and communication skills.
3. Analyze the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.
4. Interact and share their technical knowledge to enhance the leadership skills.
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

15EC610 MINI PROJECT IV 0 0 2 1

Course Objectives

- Speculate the problem identifying ability
- Improve the analyzing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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 ones 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. Formulate a real world problem, identify the requirement and develop the design solutions
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the 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	2	2	1	2		2					2	2		
3			3	2	2			2			2	2		
4		1		2	3	1	2	2						
5									3	3		2		

Total: 30 Hours

15GE611 LIFE SKILLS: APTITUDE II 0 0 2 0

Course Objectives

- The undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values

Programme Outcomes (POs)
a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
Course Outcomes (COs)

1. Perform arithmetical operations with complex numbers
2. Explain the meanings of a relation defined on a set, an equivalent relation and a partition of a set
3. Calculate percentages in real life contexts , find any percentage of a given whole using their knowledge of fraction multiplication and increase / decrease a given whole by a percentage
4. Demonstrate the situations like motion in as straight line,Boats and Streams, Trains, Races and clocks
5. Evaluate the Counting techniques, Permutation and Combination, Recursion and generating functions

Articulation Matrix

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

1 **3 Hours**

NUMBER SYSTEMS

Introduction - definition- classification on Numbers -power cycles and remainders - short cut process - concept of highest common factor - concept of least common multiple - divisibility - number of zeros in an expression

2 **3 Hours**

PERCENTAGES

Introduction - definition and Utility of percentage - importance of base/denominator for percentage calculations - concept of percentage values through additions - fraction to percentage conversion table

3 **3 Hours**

AVERAGES

Introduction - average of different groups - addition or removal of items and change in average- replacement of some of the items

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- properties-dividing a given number in the given ratio - comparison of ratios - proportions - useful results on proportion- continued proportion - relation among the quantities more than two - variation

5 **3 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-multiplying equivalents to find sale price - relation among cost price, sale price, gain/loss and percentage gain or percentage loss - an article sold at two different selling price - two different articles sold at same selling price - percentage gain or percentage loss on selling price - percentage gain or percentage loss on whole property

6 **3 Hours**

TIME AND WORK

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

7 **3 Hours**

TIME, SPEED AND DISTANCE

Definition - Basics of Time, Speed and Distance - Relative speed - Problems based on Trains? Problems based on Boats and Streams -Problems based on Races - time taken with two difference modes of transport - time and distance between two moving bodies

8 **3 Hours**

PERMUTATION AND COMBINATION

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

9 **3 Hours**

PROBABILITY

Concept and importance of probability - underlying factors for Real- Life estimation of probability - Basic facts about probability - some important consideration while defining event.

10 **3 Hours**

MIXTURES AND ALLIGATION

Definition - alligation rule - mean value (cost price) of the mixture - some typical situations where allegation can be used.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
3. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
4. Edgar Thorpe , Course In Mental Ability And Quantitative Aptitude For Competitive Examinations, Third Edition, Tata McGraw-Hill Publishing Company Ltd, 2013
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

15GE601 PROFESSIONAL ETHICS 2 0 0 2

Course Objectives

- To understand Human values, ethical theory, codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues
- To understand personal ethics, legal ethics, cultural associated ethics and engineer's responsibility

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Explain the human values.
2. Implement the importance of ethics and professionalism.
3. Illustrate the effect of social experimentation.
4. Identify the workplace responsibilities and uphold right issues
5. Construct duties pertaining to global issues.

Articulation Matrix

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

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of 'Engineering Ethics'- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlberg's and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse - Sample codes NSPE - IEEE - Institution of Engineers (India).

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl case studies - Fundamental Rights, Responsibilities and Duties of Indian Citizens -Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

Assessment Pattern

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

Assessment Questions

Remember

1. Define Human Values.
2. What are Morals and Values?
3. What do you mean by Civic virtue and Respect for others?
4. Write the various meanings of ï¿½??Spirituality?
5. List four different types of Virtues.
6. Mention different Human values.
7. What is meant by moral autonomy?
8. Classify the types of inquiry
9. What are the steps needed in confronting moral dilemmas?
10. List the levels of moral development suggested by Kohlberg
11. What do you understand by self-interest and ethical egoism?
12. What are the steps needed in confronting moral dilemmas?
13. What are the three virtues of religion?
14. What are the professional responsibilities?

Understand

1. Which are the practical skills that will help to produce effective independent thought about moral issues?
2. Why does engineering have to be viewed as an experimental process?
3. Why isn‘t engineering possible to follow a random selection in product design?
4. Why is the code of ethics important for engineers in their profession?
5. What does the Balanced Outlook on Law stress in directing engineering practice?
6. Are the engineers responsible to educate the public for safe operation of the equipment? How?
7. What kind of responsibility should the engineer have to avoid mistakes that may lead to accident due to the design of their product?
8. What is the use of knowledge of risk acceptance to engineers?
9. Why is Environmental Ethics so important to create environmental awareness to the general public?
10. Why do the engineers refuse to do war works sometimes?

Apply

1. How does the consideration of engineering as a social experimentation help to keep a sense of autonomous participation is a person's work?
2. How does the code of ethics provide discipline among the engineers?
3. Exemplify the space shuttle Challenger case accident?
4. How does the manufacturer understand the risk in a product catalog or manual?
5. How does the knowledge of uncertainties in design help the engineers to access the risk of a product?
6. How can the quantifiable losses in social welfare resulting from a fatality be estimated? Give some examples.
7. How does the engineer act to safeguard the public from risk?

15EC702 DIGITAL IMAGE PROCESSING 3 0 2 4

Course Objectives

- To make the students to understand the digital image fundamentals.
- To study the digital image using different transforms.
- To acquire the basic knowledge in filters, image enhancement, image restoration and compression techniques.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones 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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Apply the image sampling and quantization techniques and analyze images through transforms.
2. Analyze the effectiveness of spatial and frequency domain filters in an image
3. Analyze various image segmentation techniques.
4. Analyze various image restoration and recognition models.
5. Apply various image compression techniques to an image and Analyze the performance of each technique

Articulation Matrix

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

UNIT I **9 Hours**

DIGITAL IMAGE FUNDAMENTALS

Elements of digital image processing systems, Elements of visual perception, Image sampling and quantization, Basic Relationships between pixels. Image Transforms:Discrete fourier transform, Cosine, Hadamard, Haar, Walsh and Slant transform.

UNIT II **9 Hours**

IMAGE ANALYSIS

Histogram processing, Equalization and specification techniques, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Image smoothing and sharpening using frequency domain filters.

UNIT III **9 Hours**

IMAGE SEGMENTATION

Point, line and edge detection - Detection of isolated points, Line detection, Edge models, Basic edge detection, Edge linking and boundary detection. Thresholding -basic global thresholding, Otsu's method, Multiple, Variable and multivariable thresholding. Region-based segmentation - Region growing, Region splitting and merging.

UNIT IV **9 Hours**

IMAGE RESTORATION AND RECOGNITION

Image degradation/ restoration model, Noise models, Restoration - Spatial Filtering, Constrained Least square filtering, Inverse filtering, Wiener Filtering, Object recognition -Patterns and pattern classes, Matching - Minimum Distance classifiers, Neural networks-Background, Training by Back Propagation.

UNIT V **9 Hours**

IMAGE COMPRESSION

Fundamentals, Basic compression methods - Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-length coding, Lossless and Lossy predictive coding, Block transform coding, Wavelet coding.

FOR FURTHER READING

KL transform and their properties, Homomorphic filtering, Morphological image processing - Erosion and Dilation, Opening and closing, Segmentation using morphological watersheds, Applications of neural networks in image processing, Digital image watermarking.

1 **3 Hours**

EXPERIMENT 1

Perform various Image Transform

2 **3 Hours**

EXPERIMENT 2

Perform Convolution Operation on Images

3 **3 Hours**

EXPERIMENT 3

Perform various Point Processing Operations.

4 **3 Hours**

EXPERIMENT 4

Perform Bit Plane Extraction and Removal Operations.

5 **3 Hours**

EXPERIMENT 5

Perform various Image Enhancement Techniques.

6 **3 Hours**

EXPERIMENT 6

Perform Filtering Operations on Images.

7 **3 Hours**

EXPERIMENT 7

Perform Image Restoration Operation using Weiner Filtering.

8 **3 Hours**

EXPERIMENT 8

Perform Edge Detection Operations on Images.

9 **3 Hours**

EXPERIMENT 9

Perform Morphological Operations on Images.

10 **3 Hours**

EXPERIMENT 10

Perform Watermarking in Spatial and Frequency domains.

Total: 75 Hours

Reference(s)

1. C.Rafeal Gonzalez and E.Richard Woods, Digital Image Processing, Third Edition, Pearson Education 2008.
2. Anil K.Jain, Fundamentals of Digital Image Processing, PHI, 1997.
3. S Jayaraman, S Esakkirajan T Veerakumar, Digital Image Processing , Mc Graw-Hill, 2010.
4. K.William Pratt, Digital Image Processing, John Wiley, 1997.
5. M.A.Sid Ahmed, Image Processing Theory, Algorithm and Architectures, McGraw-Hill, 1995.

Assessment Pattern

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

Assessment Questions

Remember

1. Define Weber ratio.
2. Define 8-connectivity.
3. Write the procedural steps for histogram equalization.
4. Define local and global thresholding techniques.
5. Define pattern.
6. Stata the term image filtering.
7. State the role of quantisation matrix in JPEG compression.
8. Recognise blocking artifact in DCT-based image-compression scheme.
9. List the three stages of the canny edge detector and also explain each phase.
10. List the different segmentation techniques used in image processing applications.
11. List the different causes of image degradation.

Understand

1. Give some properties of Haar transform.
2. Draw 3*3 sobel and prewitt masks.
3. Give two applications of image-segmentation techniques.
4. List the advantages of a wiener filter over an inverse filter.
5. When will a constrained least square filter reduce to an inverse filter?
6. List the advantages of artificial neutral network approach to pattern recognition when compared to the traditional pattern-recognition approach.
7. Determine whether the code {0, 01, 11} is uniquely decodable or not.
8. List three reasons why image compression is important.
9. Mention the different steps employed in the coding of images using vector quantization.
10. Are convolution filters linear? Justify your answer.

Apply

1. Distinguish between scalar and vector quantization.
2. Differentiate Prewitt, Sobel and Laplacian operators.
3. Convolution in spatial domain is equivalent to multiplication in frequency domain. Prove this by a MATLAB code.
4. Compute the DCT matrix for N=4.
5. Determine the hadamard matrix of order N=8 and obtain its inverse.
6. Give the mathematical expression for a wiener filter. Also, give the advantage and drawback of a wiener filter over an inverse filter.
7. Differentiate high-pass filter and high frequency emphasis filter. How does this difference affect the resultant image?
8. Distinguish between image segmentation based on thresholding with image segmentation based on region growing techniques.
9. Compute the discrete cosine transform (DCT) matrix for N = 4.
10. Design the deblur filter using inverse and pseudo inverse filtering approaches.
11. Read an image, then corrupt the image using 'salt and pepper' noise. Now apply a 3 x 3 box filter, a 5 x 5 box filter and a median filter to the corrupted image and comment on the result obtained.

Analyse

1. Explain how zonal coding is different from threshold coding.
2. Consider the result of a 5*5 uniform averaging filter to a digital image N times. Characterise the expected effect.
3. Compare walsh and hadamard transforms with suitable examples.
4. A photograph is taken through the front window of a car moving at a constant velocity on a flat road . Because of the movement of the car, the image gets distorted. State whether this image distortion is linear or non-linear.

5. Justify the statement "Median filter is an effective tool to minise salt and pepper noise" through simple illustration.
6. If all the pixels in an image are shuffled, will there be any change in the histogram? Justify your answer.
7. Differentiate image restoration and image enhancement. What do they have in common?
8. Compare the canny edge detector with laplacian of gaussian edge detector.
9. Show that a two dimensional gaussian is separable, while the laplacian of a gaussian operator is not seperable.
10. Compare the template matching, statistical classification, syntactic method and neural network approach to pattern recognition.

Evaluate

1. Develop a perceptron for the AND function with bipolar inputs and targets.

Create

1. Derive a wiener filter for image restoration using the minimum mean square approach. Also, mention the situationn in which the behavior of a wiener filter resembles the behavior of inverse filter.
2. Derive the shannon-fano coding and arithmetic coding for the word HELLO and also relate uder which circumstanes is arithmetic coding better than huffman coding and vice versa.

15EC703 MICROWAVE ENGINEERING 3 0 0 3

Course Objectives

- To enhance the student knowledge in various parameters of microwave networks
- To equip the students with sound technical knowledge in microwave tubes
- To understand the fundamental concepts about microwave semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Analyze the working and performance of Microwave Passive Devices
2. Analyze the working and performance of Microwave tubes
3. Apply Microwave concepts to determine the various parameters of passive microwave devices
4. Analyze the working of microwave semiconductor devices
5. Analyze the performance of planar transmission lines

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

UNIT I **9 Hours**

MICROWAVE PASSIVE AND ACTIVE DEVICES AND ITS NETWORK CHARACTERIZATION

Circuit and S parameter representation of N ports- Reciprocity Theorem- Lossless networks and unitary conditions- Effect of changing the reference planes in the S matrix- S Matrix of a Directional Coupler- waveguide tees and rat race coupler- Qualitative discussion on: Waveguide Corners- Bends- Twists- Matched loads and movable shorts.

UNIT II **9 Hours**

MICROWAVE TUBES

Two cavity Klystron amplifier - Transit time effect- Velocity modulation - current modulation-bunching - Reflex Klystron- Slow-Wave structures - Helix Traveling-Wave Tubes- Convection Current- Axial Electric Field- Wave Modes- Bandwidth, Power and Gain Considerations - cross field device. Magnetron - power and frequency considerations.

UNIT III **9 Hours**

MICROWAVE MEASUREMENTS

Slotted line VSWR measurement- impedance measurement- insertion loss and attenuation measurements- measurement of scattering parameters - Return loss measurement using directional coupler-Introduction to vector network analyzer and its uses- return loss and insertion loss- Measurement of return loss and Insertion loss using Spectrum analyzer

UNIT IV **9 Hours**

MICROWAVE SEMICONDUCTOR DEVICES

Gunn-Effect -Gunn Diode- Differential Negative Resistance- Modes of Operation- Amplification- Microwave Generation- Read Diode- Physical Description- Avalanche Multiplication- IMPATT Diodes- TRAPATT Diode- BARITT Diode- Principles of Operation- Physical Structures- Parametric Amplifiers Nonlinear. Reactance and Manley Rowe Power Relations.

UNIT V **9 Hours**

PLANAR TRANSMISSION LINES

Introduction- Microstrip Lines- Derivation of Characteristic Impedance of Microstrip Lines using Quasi Static analysis- Losses in Microstrip Lines- Quality Factor Q of Microstrip Lines- Parallel Strip Lines- Characteristic Impedance-Attenuation losses- Coplanar Strip Lines- Shielded Strip Line-Problems

FOR FURTHER READING

S-parameters in amplifier design- O-type and M- type tube applications - swept-tuned spectrum analyzer- FFT spectrum analyzer-Microstrip based broadband matching networks

Total: 45 Hours

Reference(s)

1. David.M.Pozar, Microwave Engineering, John Wiley, 2003
2. Samuel.Y.Liao, MicrowaveDevices and Circuits, PHI, 2000.

3. Annapurna Das and SisirK.Das,Microwave Engineering, Tata Mc Graw-Hill,2000
4. R.E.Collin, Foundations for Microwave Engineering - IEEE Press 2002.
5. BharathiBhat, ShibanK.Koul, Stripline-like transmission lines for microwave integrated circuits, New Age International, 1999.
6. Sushrut Das,Microwave Engineering, Oxford university Press, 2014

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6								6				8						24
2	2	2									6				4				8						22
3		2				4					4				4										14
4	2					6				6					6										20
5	2					2				6				4					6						20
																								Total	100

Assessment Questions

Remember

1. Define the following losses in terms of S-parameters a. Insertion loss b. Attenuation
2. State and prove the unitary property for a lossless junction.
3. Define TWTA
4. Define wave guide
5. Define VSWR.
6. Define frequency sensitivity of variable attenuator
7. Define parametric amplifier
8. Define Gunn Effect.
9. Define partially shielded strip line
10. Define attenuation constant

Understand

1. List properties of S-parameter in microwave circuits.
2. Explain the operation of a directional coupler with the help of a sketch, showing the field lines at the junction
3. Compare O-type and M-type tubes performance with respect to their construction, bandwidth and operating power.
4. Explain working principle of magnetron with neat sketch.
5. List the applications of spectrum analyser.
6. Explain various methods of impedance matching.
7. Compare parametric amplifier and normal amplifier.
8. Explain the operation of IMPATT diode aided by suitable diagrams.
9. Distinguish between hybrid and monolithic MICs
10. List the advantages of coplanar strip line over conventional parallel strip line

Apply

1. State and prove the properties of S parameters for different characteristics of the microwave network.

2. Derive the expressions of S matrix for multiport network
3. A TWT operates with following parameters: Vb=2.5KV, Ib=25mA, Zo=10 , circuit length,L=50,f=9GHz. Find the gain parameter & powergain.
4. In a H-Plane T-Junction. Compute power delivered to the loads 40 ohm and 60ohm connected to arms 1 and 2 when 10mW power is delivered to matched port3.
5. Find the expression for characteristic impedance of a short circuited and open circuited line. Find also the values of reflection coefficient and SWR under such conditions.
6. A long transmission line carries 5kW at 500V to a matched load, a) What is the reflection coefficient at the load end, when a load of impedance 200+j100 ohm is connected? b) What is the reflection coefficient at the load end when the load is disconnected?
8. A symmetric directional coupler with infinite directivity and a forward attenuation of 20db is used to monitor the power delivered to a load. Bolometer 1 introduces a VSWR of 2on arm 4and bolometer 2 is matched to arm3. If bolometer1 reads 8mwand bolometer2reads 2mW, find (a) the amount of power dissipated in ZL (B) VSWR on arm2.
9. Derive the equation for power output & efficiency of IMPATT diode.
10. Derive the equation for power output & efficiency of TRAPATT and BARRIT diode.
11. Derive characteristic impedance for microstrip line and consider a microstrip line is constructed of a perfect conductor and a lossless dielectric board. The relative dielectric constant of the fiber glass-epoxy board is 5.23, and the line characteristic impedance is 50 ohm. Calculate the line inductance and the line capacitance.
12. A gold parallel stripline has the following parameters: Relative dielectric constant of teflon: 2.l, Strip width: w = 26 mm, Separation distance: d = 5 mm, Conductivity of gold: σc = 4.1 X l07 mho/m, Frequency: f = l0 GHz, Determine the
    a. Surface resistance of the gold strip
    b. Characteristic impedance, capacitance, inductance of the strip line
    c. Phase velocity

Analyse

1. Define electronic Admittance. Discuss its significance and the mode patterns of Reflex Klystron Oscillator.
2. Write a Schematic diagram of reflex klystron. Explain the action of the tube giving importance to Applegate diagram.
3. Explain how impedance can be measured using slotted line method.
4. Analyze the performance of IMPATT, TRAPATT & BARITT diodes.
5. Explain the possibility of negative resistance characteristics in an IMPATT diode.

Evaluate

1. A 20mW signal is fed into one of collinear port 1 of a lossless H-Plane T-Junction. Calculate the power delivered through each port when other ports are terminated in matched load.
2. In a H-Plane T-Junction. Compute power delivered to the loads 40 ohm and 60ohm connected to arms 1 and 2 when 10mW power is delivered to matched port3.
3. Calculate the length of a short-circuited line required to tune out the susceptance of a load whose Y=(0.004-j0.002) S, placed on an air-dielectric transmission line of characteristic admittance Y=00.0033S,at a frequency of 150 MHz.

4. A lossless parallel strip line has a conducting strip width w. The substrate dielectric separating the two conducting strips has a relative dielectric constant of 6 (beryllia or beryllium oxide BeO) and a thickness d of 4 mm. Calculate:
   a. The required width w of conducting strip in order to have a characteristic impedance of 50 Ω
   b. The strip-line capacitance & inductance
   c. The phase velocity of the wave in the parallel strip line
5. Define Coplanar strip line and draw its structure. Consider it has the following parameters: Relative dielectric constant of alumina: εrd = 10, Strip width: w = 4mm, Strip thickness: t = l mm, TEM-mode field intensities: Ey == 3.16 X 103 sin(πx/w) e-jβz, Hx == 63.20 sin(πx/w) e-jβz, Find the
   a. Average power flow
   b. Peak current in one strip
   c. Characteristic impedance.
6. A microstrip line is made of a copper conductor 0.254 mm (l0 mils) wide on a G-l0 fiberglass-epoxy board 0.20 mm (8 mils) in height. The relative dielectric constant of the board material is 4.8, measured at 25 GHz. The microstrip line 0.035-mm (1.4 mils) thick is to be used for l0 GHz. Determine the
   a. Characteristic impedance Zo of the microstrip line and Surface resistivity Rs of the copper conductor
   b. Conductor attenuation constant αc, dielectric attenuation constant αd
   c. Quality factors Qc and Qd

Create

1. Design a microstripline with the resonant frequency of 2.4GHz.
2. Design a coplanar stripline for wireless applications

15EC704 BROADBAND MOBILE CELLULAR COMMUNICATIONS — 3 0 0 3

Course Objectives

- To understand the basic cellular system concepts.
- To have an insight into the various propagation models and the multiple access techniques in mobile communication.
- To gain knowledge of the various cellular mobile 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.

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.
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 ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Organize the Cellular networks and appreciate the differences with fixed networks
2. Analyze the various propagation models and the multiple access techniques in mobile communication.
3. Analyze the working of CDMA Technology for various communication systems
4. Assess the capacity of wireless channels for mobile communication
5. Analyze the various MIMO channels for 4G Newtorks

Articulation Matrix

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

UNIT I **8 Hours**

WIRELESS CHANNEL: PROPAGATION AND FADING

Large-Scale Fading-Small-Scale Fading - Detection in a Rayleigh fading channel, Time diversity, Antenna diversity, Frequency diversity, Impact of channel uncertainty

UNIT II **9 Hours**

CELLULAR CONCEPTS AND SYSTEM DESIGN FUNDAMENTALS

Introduction to Cellular Concepts: Frequency reuse, Channel assignment, Hand off strategies, Interference and system capacity. OFDM: single carrier vs. multicarrier transmission-basic principles of OFDM-OFDMA.

UNIT III **9 Hours**

WIDEBAND SYSTEMS

GSM system-network and protocol architecture-GPRS- Wideband systems: CDMA -uplink and downlink, System issues. 3G: UMTS network protocol architecture.

UNIT IV **9 Hours**

CAPACITY OF WIRELESS CHANNELS

AWGN channel capacity- Resources of the AWGN channel- Linear time-invariant Gaussian channels- Single input multiple output (SIMO) channel, Multiple input single output (MISO) channel,-Capacity of fading channels.

UNIT V **10 Hours**

MULTIUSER CAPACITY AND OPPORTUNISTIC COMMUNICATION

Multiplexing capability of deterministic MIMO channels -Physical modeling of MIMO channels- Modeling of MIMO fading channels-4G networks:Long Term Evolution.

FOR FURTHER READING

Improving Coverage and capacity in Cellular systems, Statistical models for multipath fading channels, Spectral Efficiency of different Wireless Access Technologies, Role of IP in GPRS and UMTS, IPv6, Concepts of 5G, IoT

Total: 45 Hours

Reference(s)

1. David Tse and Pramod Viswanath, Fundametals of Wireless Communication,Cambridge University Press, 2005.
2. T.S.Rappaport and Viswanath, Fundamentals of wireless communication, Cambridge Press 2009.
3. Yong Soo Cho, Jaekwon Kim,Won Young Yang, Chung G. Kang, MIMO-OFDM Wireless Communications With Matlab, IEEE Press, John Wiley, 2010.
4. Iti Saha Misra, Wireless Communications and Networks: 3G and Beyond, McGraw Hill Education (India) Pvt Ltd, 2013 T.S.Rappaport, Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.
5. T.S.Rappaport, Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.
6. R. Blake, Wireless Communication Technology, Thomson Delmar, 2003.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				4				6										20
2		2				4					4			4					8						22
3	2					4				4				4											14
4	2					2					6			4					8						22
5		2				2				8				4				6							22
																								Total	100

Assessment Questions

Remember

1. Define channel assignment.

2. Recall frequency reuse.
3. State the various types of hand-offs
4. List the various models of radio propagation.
5. State Doppler Effect
6. Recall Small scale fading
7. List the design goals of CDMA
8. List the three algorithms used for authenticating in 2G systems
9. Recall the different UMTS air interfaces
10. Name the various channel assignment strategies.
11. List the types of services offered by GSM.
12. Recall HLR and VLR with respect to 2G networks.
13. Recall the functions of Node B in UMTS network.
14. Illustrate the UTRA-TDD frame structure

Understand

1. Distinguish between static and dynamic channel assignment strategies.
2. Bring out the differences between various multiple access techniques.
3. Classify the different types of fading
4. Infer on the two propagation model.
5. Explain OFDM
6. Infer on the need for synchronization in GSM network.
7. Illustrate the architecture of DECT.
8. Infer on the modifications carried out in UE of UMTS with respect to MS of GSM network

Apply

1. Estimate the Truncking capacity for a given cluster size and reuse factor.
2. Derive the BER for OFDM systems
3. Compute the power at the receiver in freespace propagation model
4. Assess the effect of reflection, diffraction, scattering on radio signals
5. Consider an area of 1000 sq.km to be covered by a cellular network. If each user requires 25KHz for communication and total available spectrum is 50 MHz,Â (i) How many users can be supported without frequency reuse?
6. Consider an area of 1000 sq.km to be covered by a cellular network. If each user requires 25KHz for communication and total available spectrum is 50 MHz,Â (i) If cells of area 50 sq.km are used, how many users can be supported with cluster size of 3,5 and 7?

Analyse

1. Compare and Contrast small scale and large scale fading
2. Outline the Working of OFDM systems
3. Outline the typical steps involved in performing handover in a cellular network. Also, compare and contrast the different types of handover mechanisms.
4. Outline the architecture of a 2G GSM networkÂ and attribute to the individual components of the same.
5. Outline the architecture of a 2.5G GPRS networkÂ and attribute to the importance of SGSN and GGSN in providing internet access to the mobile users.
6. Compare and Contrast 2G and 3G Cellular networks.
7. Outline the functions carried out by the Radio Network Controller (RNC) in an UMTS network.
8. Attribute to the different types of handover mechanisms adapted in UMTS network with necessary illustrations.

Evaluate

1. Critique on the trends in cellular and mobile communication technologies.
2. Outline on the main problems of signal propagation in an wireless medium. Why Reflection is considered to be both useful and harmful? Justify.

3. Outline the architecture of a 3G UMTS networkÂ and critique on the methodologies adapted in order to support higher data rates.

15EC707 MICROWAVE ENGINEERING LABORATORY **0 0 2 1**

Course Objectives

- To understand the importance of various microwave components in several communication applications.
- To study the performance of microwave components using certain performance estimation parameters
- To learn 'ADS' simulation software by designing a patch antenna

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.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze the mode characteristics of Reflex Klystron, VI characteristics of Gunn Diode
2. Calculate the power distribution in microwave components, scattering parameters of various Tees.
3. Compute the frequency and wavelength of rectangular and circular waveguides
4. Analyze the performance of Horn, Patch and Parabolic antenna and its radiation pattern
5. Design and analyze the performance of microstrip patch antenna using ADS software

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Study of Microwave components

2 **2 Hours**

EXPERIMENT 2

Reflex klystron characteristics

3 **2 Hours**

EXPERIMENT 3

Gunn diode VI characteristics

4 **2 Hours**

EXPERIMENT 4

VSWR measurement (low and High VSWR)

5 **2 Hours**

EXPERIMENT 5

Attenuation measurement, Impedance and frequency measurement

6 **2 Hours**

EXPERIMENT 6

Directional coupler characteristics

7 **2 Hours**

EXPERIMENT 7

Scattering parameters of E-plane Tee, H-plane and Magic Tee

8 **2 Hours**

EXPERIMENT 8

Radiation Characteristics of Horn Antenna and Parabolic antenna

9 **2 Hours**

EXPERIMENT 9

Frequency and wavelength determination in a rectangular wave guide working in TE10 mode.

10 **2 Hours**

EXPERIMENT 10

Study of Circulator and Isolator characteristics

11 **2 Hours**

EXPERIMENT 11

Design and simulation of microwave couplers

12 **4 Hours**

EXPERIMENT 12

Design of Linear and circular polarisation of antennas

13 **4 Hours**

EXPERIMENT 13

Design and Simulation of transmission and reception using advanced antennas

Total: 30 Hours

Reference(s)

1. David.M.Pozar, Microwave Engineering, John Wiley, 2003.
2. Annapurna Das and SisirK.Das,Microwave Engineering, Tata Mc Graw-Hill,2000
3. R.E.Collin, Foundations for Microwave Engineering- IEEE Press 2002.
4. BharathiBhat, ShibanK.Koul, Stripline-like transmission lines for microwave integrated circuits, New Age International, 1999

15EC708 BROADBAND MOBILE CELLULAR COMMUNICATIONS LABORATORY

0 0 2 1

Course Objectives

- To understand the wireless channel and propagation in cellular communication.
- To study and analyze the calling and handover procedure in mobile communication.
- To analyse the performance of the various cellular system.

Programme Outcomes (POs)

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

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

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

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

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

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

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Solve engineering problems related to Mobile Radio propagation
2. Appreciate the concepts behind Orthogonal Frequency Division Multiplexing
3. Infer on the evolution and working of GSM cellular networks.
4. Experiment on working of UMTS 3G cellular networks.
5. Infer on the working of wide band cellular network.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Channel model for large scale fading.

2 **2 Hours**

EXPERIMENT 2

Channel model for small scale fading.

3 **4 Hours**

EXPERIMENT 3

Analysis and comparison of BPSK/QPSK BER performance in Rayleigh and Racian fading channel.

4 **4 Hours**

EXPERIMENT 4

Generation of OFDM modulation and demodulation schemes.

5 **4 Hours**

EXPERIMENT 5

BER simulation of OFDM system over multipath fading channel.

6 **4 Hours**

EXPERIMENT 6

Simulation of Alamouti Space Time Codes.

7 **2 Hours**

EXPERIMENT 7

Simulation of Frequency Division Multiple Access.

8 **4 Hours**

EXPERIMENT 8

Generation of Correlated MIMO Fading Channels.

9 **2 Hours**

EXPERIMENT 9

Simulation of CDMA transmitter and receiver using MATLAB.

10 **2 Hours**

EXPERIMENT 10

Direct sequence spread spectrum modulation and demodulation.

Total: 30 Hours

Reference(s)

1. David Tse and Pramod Viswanath, Fundametals of Wireless Communication,Cambridge University Press, 2005

15EC709 MINI PROJECT V **0 0 2 1**

Course Objectives

- Speculate the problem identifying ability
- Improve the analyzing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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 ones 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. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

15GE710 LIFE SKILLS : COMPETITIVE EXAMS 0 0 2 0

Course Objectives

- To understand the concepts of networks and signals and systems.
- To understand the concepts of analog and digital circuits.
- To remember the analog and digital communication concepts.

Course Outcomes (COs)

1. Explore the concepts of networks and signals & systems.
2. Elucidate the concepts of analog and digital circuits.
3. Explain the concepts of analog and digital communications.

UNIT I **10 Hours**

NETWORKS, SIGNALS AND SYSTEMS

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton’s, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Frequency domain analysis of RLC circuits; Linear 2-port network parameters.

Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties.

UNIT II **10 Hours**

ANALOG AND DIGITAL CIRCUITS

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Digital Combinational circuits: Arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

UNIT III **10 Hours**

COMMUNICATIONS

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Total: 30 Hours

Reference(s)

1. M.E. Van Valkenburg., "Networks Analysis ", Prentice Hall of India, 2005.
2. Ravish R Singh, "Electrical networks ", Tata McGraw Hill, 2009.
3. Adel. S. Sedra, Kenneth C. Smith, Microelectronic Circuits Theory an Applications ,5th Edition, Oxford University, 2006.
4. Jacob Millman, C. Halkias and Satyabrata Jit Electronic Devices and Circuits, 3rd Edition, Tata McGraw-Hill, 2011
5. G.Kennedy and B.Davis, Electronic Communication Systems, fourth Edition , Tata McGraw-Hill -2008.
6. Simon Haykin, Communication Systems, John Wiley, 2001.
7. Simon Haykins, Digital Communication John Wiley, 2001.
8. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011

15EC804 PROJECT WORK 0 0 0 9

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

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

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

LANGUAGE ELECTIVES

15LE101 BASIC ENGLISH I

3 0 0 3

Course Objectives:

- To teach students basic English vocabulary and tenses
- To offer practice on various conversation patterns
- To improve spelling and pronunciation by offering rigorous practice and exercises

Programme Outcomes (POs)

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

Course Outcomes (COs):

Students will be able to:

1. Form sentences using basic grammar and vocabulary in English
2. Converse in basic day-to-day situations
3. Speak on topics of general interest
4. Listen and comprehend Indian English audio clippings
5. Read passages and answer related questions

Program Outcomes (POs) Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	1	-	-
2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-
5	-	-	-	-	-	-	-	-	-	2	-	-

UNIT I **7 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
1	Basic words- 12 most used words in English, usage and pronunciation	Starting a conversation and talking about what one does	Sentence construction bolstered by mother tongue
2	Basic words- 20 often used words, usage and pronunciation	Analyzing an action plan	Creating and presenting one's own action plan
3	Basic words with a focus on spelling	Discriminative listening	Informal conversation
4	Basic words- 10 often used words, usage and pronunciation	Content listening and Intonation	Reading comprehension
5	Unit Test I		

UNIT II **8 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
6	Basic words + greetings to be used at different times of the day	Formal conversation	Intonation to be used in formal address
7	Last 28 of the 100 most used words	Informal conversation between equals	Reading practice and peer learning
8	Using the 14 target words to form bigger words	Informal dialogues using contracted forms	Guided speaking- talking to peers using contracted forms
9	Palindromes, greetings- good luck, festivals	Placing a word within its context- culling out meaning	Offering congratulations
10	Unit Test II		

UNIT III **7 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
11	Homophones	Formal and informal methods of self-introduction	Let's Talk is a group activity that gives them some important pointers of speech
12	Homophone partners, matching words with their meanings	Contracted forms of the – be verbs, 've and 's	Translating English sentences to Tamil

13	Briefcase words- finding smaller words from a big word	Formal and informal ways of introducing others	Team work- speaking activity involving group work, soft skills
14	Compound words and pronunciation pointers	Giving personal details about oneself	Using the lexicon
15	Unit Test III		

UNIT IV **8 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
16	Proper and common nouns	Asking for personal information and details	Pronunciation pointers- an informal introduction to the IPA
17	Pronouns	Telephone skills and etiquette	Reading aloud and comprehension
18	Abstract and common nouns	Dealing with a wrong number	Reading practice and comprehension
19	Group names of animals, adjectives	Taking and leaving messages on the telephone	Pronunciation pointers
20	Unit Test IV		

UNIT V **8 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
21	Determiners	Interrupting a conversation politely- formal and informal	Pair work reading comprehension
22	Conjugation of the verb ‘to be’- positive and negative forms	Thanking and responding to thanks	Comprehension questions that test scanning, skimming and deep reading
23	Am/is/are questions	Giving instructions and seeking clarifications	Small group activity that develops dialogue writing
24	Present continuous tense-form and usage	Making inquiries on the telephone	Finishing sentences with appropriate verbs
25	Unit Test V		

UNIT VI **7 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
26	Words with silent 'b' Present continuous questions	Calling for help in an emergency	Dialogue writing
27	Words with silent 'c' Simple present tense- form and usage	Making requests and responding to them politely	Identifying elements of grammar in text extract
28	Simple present tense- rules	Describing people	Guided writing
29	Words with silent 'g' Questions in the simple present tense	Describing places	Filling in the blanks with correct markers of tense
30	Unit Test VI		

Total: 45 hours

Resource:

1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE102 COMMUNICATIVE ENGLISH I

Course Objectives

- To communicate effectively in social scenario
- To enhance the ability of reading, summarising and paraphrasing information
- To develop the techniques of writing through appropriate use of grammar and vocabulary

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Listen and comprehend different spoken discourses
2. Communicate ideas in English fluently during personal / official conversations
3. Apply grammar and vocabulary required at CEFR B1 level in spoken and written discourses
4. Read and comprehend general & technical text
5. Apply appropriate mechanics of writing in formal written communication

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	2	-	-
2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	-	-	1	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-

UNIT I: GRAMMAR AND VOCABULARY 9 Hours
Content words and Structural words - Verbs and verb phrase - Subject - Verb agreement -Tenses - Active voice and passive voice - Sentence types (declarative, imperative, exclamatory & interrogative) - Framing questions - Comparative adjective

UNIT II: LISTENING 9 Hours
Listening for specific information: Short conversations / monologues - Impersonal passive - Gap filling - Telephone conversations - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Telephone etiquette

UNIT III: READING 9 Hours
Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure - Note Making

UNIT IV: WRITING 9 Hours
Letter Writing: Formal letters / Job application - E-mail writing – Report & Proposal writing - Advertisement - Principles of writing a good paragraph: Unity, cohesion and coherence - Paragraph writing (descriptive, narrative, expository & persuasive)

UNIT V: SPEAKING 9 Hours
Self-introduction (Elevator Pitch) - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Likes and dislikes - Tongue twisters

FOR FURTHER READING
Short stories:
"The Astrologer's Day" by R. K Narayan
"How Much Land does a Man Need?" by Leo Tolstoy

Total: 45 Hours

References:

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. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian edition. New Delhi: Oxford University Press. 2005.

3. Anderson, Kenneth. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press. 2004.

15LE201 BASIC ENGLISH II

3 0 0 3

Course Objectives:
- To focus on natural acquisition of rudimentary structures in English language through ample listening, reading and writing inputs
- To concentrate on speaking and conversation skills with a view to increase fluency in speaking
- To enhance the ability of correct pronunciation and spelling

Programme Outcomes (POs)

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

Course Outcomes (COs)
1. Speak clearly in English to individuals / groups without hesitation
2. Comprehend simple day-to-day formal/ informal conversations
3. Apply appropriate tenses and verbs in writing
4. Read and comprehend paragraphs on simple topics
5. Write coherent paragraphs / reports / letters on familiar topics

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	3	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-
3	-	-	-	-	-	-	-	-	-	1	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-

UNIT I **7 Hours**

Module	Vocabulary/ Grammar	Skills Sets	Skill Sets
31	Difference between Present Continuous and Simple Present tense	Calling for help in an emergency	Reporting an event-journalistic style
32	Verbs ‘have’ and ‘have got’	Describing animals	Asking for and giving directions
33	Simple Past Tense	Inviting people, accepting and declining invitations	Self- enquiry and offering one’s opinion on a given topic

34	Spelling rules & table of Irregular Verbs	Refusing an invitation	Reading and practicing pre-written dialogues
35	Unit Test I		

UNIT II **8 Hours**

36	Questions and the negative form of the simple past tense	Apologizing and responding to an apology	(Reading) conversation practice
37	Asking questions in the simple past tense	Reading comprehension	Seeking, granting and refusing permission
38	Past continuous tense	Paying compliments and responding to them	Pair work: writing dialogues and presenting them
39	Difference between simple past and past continuous- when and where to use each	Describing daily routines	Reading and comprehension skills
40	Unit Test II		

UNIT III **7 Hours**

41	Simple future tense	Talking about the weather	Making plans- applying grammar theory to written work
42	Simple future tense- more aspects, possessive pronouns	Talking about possessions	Opening up and expressing one's emotions
43	Future continuous tense	Talking about current activities	Listening comprehension
44	Revision of future tense- simple and continuous forms, prepositions used with time and date	Asking for the time and date	Discussion- analyzing and debating a given topic
45	Unit Test III		

UNIT IV **8 Hours**

46	Articles a/an	Writing, speaking and presentation skills	Transcribing dictation
47	Singular- Plural (usage of a/an)	Reading practice- independent and shared reading	Comprehension –logical analysis, process analysis and subjective expression

48	Countable and uncountable nouns- a/an and some	Listening comprehension	Vocabulary: using context tools to decipher meaning
49	Articles- the	Sequencing sentences in a paragraph	Listening to a poem being recited, answer questions on it and practice reciting the same
50	Unit Test IV		

UNIT V **7 Hours**

51	Articles- the: usage and avoidance	Speaking: sharing stories about family, village/town, childhood, etc. 10 students	Listening: comprehend and follow multiple step instructions read out by the teacher
52	Articles- the: usage and avoidance with like and hate	Speaking: sharing stories about family, village/town, childhood, etc. 10 students	Reading: Make inferences from the story about the plot, setting and characters
53	Articles- the: usage and avoidance with names of places	Speaking: sharing stories about family, village/town, childhood, etc. 10 students	Comprehension passage
54	This/ that/ these and those	Writing a notice- announcement	Speaking: Debate
55	Unit Test V		

UNIT VI **8 Hours**

56	One and ones	Collaborative learning- problem solving	Writing short answers to questions based on reading
57	Capitalization and punctuation	Controlled writing	Listen to a story and respond to its main elements
58	Syntax and sentence construction- rearrange jumbled sentences	Guided writing	Listen to a poem and discuss its elements
59	Cloze Test	Free writing	Frame simple yet purposeful questions about a given passage
60	Unit Test VI		

Total: 45 hours

Resource:

1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE202 COMMUNICATIVE ENGLISH II

3 0 0 3

Course Objectives

- To acquire skills for using English language effectively in workplace
- To prepare students for taking BEC Vantage level examination
- To enhance the communicative ability from Intermediate to Upper Intermediate level
- To enhance the communicative ability from Intermediate to Upper Intermediate level

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Apply language structures and vocabulary required at CEFR B2 level in spoken and written discourses
2. Listen and comprehend different business conversations
3. Read and comprehend general & technical text
4. Apply appropriate mechanics of writing in formal written communication
5. Communicate effectively through formal and informal spoken and written business correspondences

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	3	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-
4	-	-	-	-	-	-	-	-	-	1	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-

UNIT I: GRAMMAR AND VOCABULARY **9 Hours**

Simple, Compound and Complex sentences - Direct and Indirect speech - Conditionals -Business vocabulary - Collocations - Discourse markers

UNIT II: LISTENING **9 Hours**

Listening to specific information - short notes - Listening to identify topic, content, function - Sentence stress - Rhythm - Intonation

UNIT III: READING **9 Hours**

Reading graphs and charts - Skimming and scanning texts - Gap Filling - Read business articles for specific information - Understanding the structure of a text - Error identification

UNIT IV: WRITING **9 Hours**

Formal and Informal English - Business Correspondence, Short Documents: e-mail, memo, message, - Longer Documents: Reports and Proposals - Transcoding

UNIT V: SPEAKING **9 Hours**

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging information - Language Functions: suggesting - comparing and contrasting - expressing - Finding out facts, attitudes and opinions - Commonly mispronounced words

FOR FURTHER READING

Newspaper and Magazine reading (The Hindu / The New Indian Express / Times of India, India Today / Readers' Digest) -Reading Novels (The Monk Who Sold His Ferrari by Robin Sharma; Three Mistakes by Chetan Bhagat; The Fountain head by Ayn Rand)

Total: 45 Hours

References:

1. Guy Book- Hart, BEC Vantage Cambridge Business Benchmark, Upper-Intermediate Cambridge University Press, 2006.
2. Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course in Reading for Academic Purposes. United Kingdom: Cambridge University Press, 2004.

15LC203 CHINESE

3 0 0 3

Course Objectives

- To help students acquire the basics of Chinese language
- To teach the student show to converse in Chinese in various situations
- To teach Chinese cultural facets and social etiquettes to the students

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify Initials and Finals of Chinese Alphabet
2. Recognise four different tones in a spoken Chinese sentence
3. Read Mandarin Chinese through Pinyin
4. Form sentences using basic Chinese vocabulary
5. Listen and comprehend basic Chinese conversation

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	1	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-
4	-	-	-	-	-	-	-	-	-	3	-	-
5	-	-	-	-	-	-	-	-	-	2	-	-

UNIT I **9 Hours**

Nǐhǎo-你好

Xuéhuìwènhòu de jīběnbiǎodáyòngyǔ - 学会问候的基本表达用语；Xuéhuìjièshàozìjǐ de xìngmíng, guójí - 学会介绍自己的姓名，国际 ；Xuéhuìhànyǔpīnyīn de shèngmǔ - 学会汉语拼音的圣母 ； yùnmǔhéshēngdiào - 韵母和声调 ；Pīndúhéshēngdiàoliànxí - 拼读和声调练习

UNIT II **9 Hours**

Xiànzàijǐdiǎn-现在几点

Xuéhuìshíjiān, rìqí de biǎodá - 学会时间，日期的表达 ; Rèshēn - 热身 ; Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ;Huódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ; Xuécíyǔshuōshíjiān ; Tìhuànliànxí - 替换练习Dúyīdúránhòuliánxiàn - 读一读然后连线 ; Bǎxiàmiàn de cíànzhèngquè de shùnxùpáilièchéngjù - 把下面的词按正确的顺序排列成句

UNIT III **9 Hours**

Nàjiànmáoyīzěnmemài? - 那件毛衣怎么卖？

Xúnwènjiàqiánjíqián de biǎodá - 询问价钱及钱的表达 ; Tǎojiàhuánjià - 讨价还价 ; Tíchūduìsuǒmǎidōngxīdàxiǎo,yánsèděngděngjùtǐyāoqiú-
提出对所买东西大小，颜色等等具体要求； ShēngcíHuódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ; Xuécíyǔshuōshíjiān ;Dúyīdúránhòuliánxiàn - 读一读然后连线 ;Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表

UNIT IV **9 Hours**

Xuéhuìxúnwènjiātíngqíngkuàng, zhíyèhéniánlíng - 学会询问家庭情况，职业和年龄

Xuéhuìdiǎncàitíyāoqiújiézhàng - 学会点菜提要求结账 ；Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ;Huódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ; Xuécíyǔshuōshíjiān ;Dúyīdúránhòuliánxiàn - 读一读然后连线 ;Tīnglùyīnxuǎnzézhèngquèdá'àn -

听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表Juésèbànyǎn - 角色扮演 ; Tīnglùyīnpànduànduìcuò - 听录音判断对错

UNIT V **9 Hours**

Nǐzàinǎ'ergōngzuò -你在哪儿工作

Xuéhuìxúnwènjiātíngqíngkuàng, zhíyèhéniánlíng- 学会询问家庭情况，职业和年龄Shēngcí - 生词 ; Jùzi - 句子 ; Huìhuà - 会话 ; Huódòng - 活动 ; Kàntúwánchénghuìhuà - 看图完成会话 ;Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表 - Tīnglùyīnxuǎnzézhèngquèdá'àn - 听录音选择正确答案 ; Bǔchōngcíyǔbiǎo - 补充词语表

Total: 45 Hours

References:

1. David J. White. My Chinese Classroom, 2005
2. Tiyan Hanyu Shenghuo Pian, Experiencing Chinese, Ying Yu Ban Di 1 Ban. Beijing: Higher Education Press: Gaodengjiaohuchu ban she. 2011

Software:

1. Hancel, Don. Mandarine Day. Chinese learning Software

Websites:

1. www.chinesexp.com.cn
2. www.yiwen.com.cn

15LF203 FRENCH

3 0 0 3

Course Objectives

- To help students acquire familiarity in the French alphabet & basic vocabulary
- To teach the students to use French in simple day-to-day conversations
- To prepare the students for French examination (level A1)

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Listen and comprehend individual sounds of French and simple day-to-day conversations
2. Apply basic sounds and words in simple sentences for communication
3. Read and comprehend short passages on familiar topics
4. Frame basic sentence structures while writing
5. Recognize and apply basic grammar and appropriate vocabulary in completing language tasks

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	2	-	-
2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-
4	-	-	-	-	-	-	-	-	-	3	-	-
5	-	-	-	-	-	-	-	-	-	1	-	-

Unit I **6 Hours**

Alphabet Français et Les Accents Français - Les articles définis, indéfinis Genre - Singulier et pluriel - Salutations

Unit II **8 Hours**

Verbes - Conjugaison : Présent (Avoir / Être / ER, IR, RE : Régulier et Irrégulier) - Adjectifs - Nationalités - Professions - Formuler les questions **LIRE**

Unit III **8 Hours**

Les jours de la semaine - Les mois de l'année - Les saisons - Numéros - Quelle heure est - il ? - Famille - Articles Contractés - Préposition - Adjectifs Possessifs **PARLER :** Se présenter **; LIRE**

UNIT IV **9 Hours**

Verbes - Conjugaison : Impératif, Futur proche, Passé-récent (ER / IR / RE : Régulier et Irrégulier) - Articles Partitifs - Adjectifs Démonstratifs - La Gastronomie Française. **PARLER ; LIRE**

UNIT V **14 Hours**

Verbe Conjugaison : Passé-composé, Imparfait, Futur simple, Conditionnel (ER / IR / RE : Régulier et Irrégulier) - Carte Postale - Courriel **PARLER :** Jeu de Rôle**; ÉCOUTER** Compréhension Orale

Total : 45 Hours

References

1. Grammaire Progressive du Français, CLÉ International, 2010.
2. Collins Easy Learning French Verbs & Practice, Harper Collins, 2012.
3. Barron's Learn French, 3rd Edition, Elizabeth Bourquin, Language Institute, 2012.
4. Cours de Langue et de Civilisation Françaises, G. Mauger, Hachette, 2014.
5. Saison 1, Marie-Noëlle Cocton et al, Didier, 2014.

Softwares

1. Français Linguaphone : Linguaphone Institute Ltd., London, 2000.
2. Français Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001.

15LG203 GERMAN

3 0 0 3

Course Objectives

- To help students acquire the basics of German language
- To teach them how to converse in German in day-to-day situations

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Listen and identify individual sounds of German and simple day-to-day conversations
2. Speak simple sentences using basic sounds and words
3. Read and understand short passages on familiar topics
4. Apply basic sentence structures while writing
5. Apply basic grammar and appropriate vocabulary in completing language tasks

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	2	-	-
2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-
4	-	-	-	-	-	-	-	-	-	3	-	-
5	-	-	-	-	-	-	-	-	-	1	-	-

UNIT I **6 Hours**

Introduction to German language: Alphabets - Numbers - Greetings - country - nationalities - Working with Dictionary.

UNIT II **6 Hours**

Nouns – Pronouns - definite and indefinite article - Speaking about oneself - Listening to CD supplied with the books, paying special attention to pronunciation.

UNIT III **11 Hours**

Regular verbs - Conjugation - Irregular verbs - Time - Negation - adjectives - family - profession - Introduction to types of sentences.

UNIT IV **12 Hours**

Question words - Types of Questions - Nominative - Accusative and dative case - framing basic questions and answers - Writing short notes and letter- reading the news boards, directions.

UNIT V **10 Hours**

Imperative case - Possessive articles - propositions - modal auxiliaries - Basic dialogue and group conversation - ordering in restaurants.

Total: 45 Hours

References:

1. Continuum International Publishing Group Ltd. London / New York, 1992. Eckhard, Christine. Whittle, Black & Ruth. Cassel Language Guides - German.
2. Rusch, Paul. Netzwerk A1. Deutsch AlsFremdsprache. Goyal Publishers & Distributers Pvt. Ltd. New Delhi, 2015.
3. Langenscheidt Universal German Dictionary: German-English, English-German. Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
4. Grundkurs Deutsch A Short Modern German Grammar Workbook and Glossary. Verlag Fur Deutsch.Munichen, 2007.
5. Grundkurs. Deutsch Lehrbuch. Hueber. Munichen, 2007.

15LH203 HINDI

3 0 0 3

Course Objectives

- To help students acquire the basics of Hindi language
- To teach them how to converse in Hindi in day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Read and identify Hindi letters, words and simple sentences
2. Construct simple sentences and use appropriate vocabulary during day-to-day oral communication
3. Identify basic sounds of Hindi language and understand simple conversations on familiar topics
4. Write common words and sentences
5. Comprehend elementary level grammar of Hindi.

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	2	-	-
2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-
4	-	-	-	-	-	-	-	-	-	3	-	-
5	-	-	-	-	-	-	-	-	-	1	-	-

Unit I **9 Hours**
Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

Unit II **9 Hours**
Nouns: Genders (Masculine & Feminine Nouns ending in - ā,i,ī, u,ū)- Masculine & Feminine – Reading Exercises.

Unit III **9 Hours**
Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

Unit IV **9 Hours**
Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

Unit V **9 Hours**
Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

References:

1. Kishore B.R., Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.
2. Dakshin. Dakshin Bharath Hindi Prachar Sabha, Chennai. 2016.
3. Videos, Stories, Rhymes and Songs.

15LJ203 JAPANESE

3 0 0 3

Course Objectives

- To help students learn Japanese alphabet
- To teach students how to use the basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Program Outcomes (POs) Mapping

CO	PO1	PO2	Po3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-	-	-	-	-	-	3	-	-
2	-	-	-	-	-	-	-	-	-	1	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-
4	-	-	-	-	-	-	-	-	-	1	-	-
5	-	-	-	-	-	-	-	-	-	2	-	-

UNIT I **9 Hours**

Introduction to Japanese - Japanese script - Pronunciation of Japanese (Hiragana) - Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 des - N1 wa N2 ja arimasen - S ka - N1mo - N1 no N2 - …….san - Kanji - Technical Japanese Vocabulary (25 Numbers) - Phonetic and semantic resemblances between Tamil and Japanese

UNIT II **9 Hours**

Introduction - Kore - Sore - are - Kono N1 - Sono N1 - ano N1 - so des - so ja arimasen - S1 ka - S2 ka - N1 no N1 - so des ka - koko - soko - asoko - kochira - sochira - achira - N1 wa N2 (Place) des - dhoko-N1 no N2 - Kanji-10 - ima….ji…fun des - Introduction of verb - V mas - V masen - V mashitha - V masen deshitha - N1(Time) ne V - N1 kara N2 des - N1 tho N2 / S ne Kanji-10 - Technical Japanese Vocabulary (25 Numbers) - Dictionary Usage.

UNIT III **9 Hours**

- N1(Place) ye ikimas - ki mas - kayerimasu - Dhoko ye mo ikimasen - ikimasendheshitha - N1(vehicle) de ikimasu - kimasu - kayerimasu - N1(Personal or Animal) tho V ithsu - S yo. - N1 wo V (Transitive) - N1 wo shimus - Nani wo shimasu ka - Nan & Nani - N1(Place) de V - V masen ka - V masho - Oo……. Kanji-10 , N1(tool - means) de V - " Word / Sentence " wa …go nan des ka - N1(Person) ne agemus - N1(Person) ne moraimus - mo V shimashitha - , Kanji-10 – Japanese Typewriting using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

UNIT IV **9 Hours**

Introduction to Adjectives - N1wanaadj des. N1 wa ii adj des - naadjna N1 - ii adj ii N1 - Thothemo - amari - N1 wadho des ka - N1 wadhonna N2 des ka - S1 ka S2 - dore - N1 gaarimasu - wakarimasu - N1 ga suki masu - N1 gakiraimasu - jozu des - hetha des - donna N1 - Usages of yoku - dhaithai - thakusan - sukoshi - amari - zenzen - S1 kara S2 - doshithe, N1 gaarimasu - imasu - N1(Place) ne N2 gaarimasu - iimasu - N1 wa N2(Place) ne arimasu - iimasu - N1(Person,Place,or Thing) no N2 (Position) - N1 ya N2, Kanji-10 - Japanese Dictionary usage using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

UNIT V **9 Hours**

Saying Numbers , Counter Suffixes - Usages of Quantifiers -Interrogatives - Dhonokurai - gurai –Quantifier - (Period) ne ….kai V - Quantifier dhake / N1 dhake Kanji - Past tense of Noun sentences and na Adjective sentences - Past tense of ii-adj sentences - N1 wa N2 yoriadj des - N1 tho N2 thoDhochiragaadj des ka and its answering method - N1 [no naka] de {nani/dhoko/dhare/ithsu} ga ichiban adj des ka - answering -N1 gahoshi des - V1 mas form dhake mas - N1 (Place) ye V masu form ne ikimasu/kimasu/kayerimasu - N1 ne V/N1 wo V - Dhokoka - Nanika – gojumo - Technical Japanese Vocabulary (25 Numbers)

Total: 45 hours

References:

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Software:

1. Nihongo Shoho-1
2. Nihongo Shoho-2
3. JWPCE Software

Websites:

1. www.japaneselifestyle.com
2. www.learn-japanese.info/
3. www.kanjisite.com/
4. www.learn-hiragana-katakana.com/typing-hiragana-characters/

PHYSICS ELECTIVES

15PH201 PHYSICS OF MATERIALS 3 0 2 4

Course Objectives

- To understand the physical properties of conductors, semiconductors and superconductors
- To recognize the basic principles of interaction of light with matter and working of optical devices
- To classify the types of dielectric, magnetic materials and polarization mechanisms with their properties

Programme Outcomes (POs)

a. 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.
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. Analyze the properties of conductors and superconductors for different applications
2. Apply the concepts and types of semiconductors for solar cell applications
3. Discuss the types, properties and applications of dielectric materials
4. Explain the properties of optical materials, working mechanism of LEDs and LCDs
5. Classify the magnetic materials with their properties and apply in the data storage devices

Articulation Matrix

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

UNIT I **9 Hours**

CONDUCTING AND SUPERCONDUCTING MATERIALS

Electrical and thermal conductivity of metals - Wiedemann Franz law - band theory of metals - density of states. Superconductors: properties - types - High Tc superconductors- applications.

UNIT II **10 Hours**

SEMICONDUCTORS

Elemental and compound semiconductors - intrinsic semiconductors: carrier concentration - electrical conductivity- band gap. Extrinsic semiconductors: carrier concentration - variation of Fermi level. Hall effect: theory and experimental determination -applications: Solar cells

UNIT III **9 Hours**

DIELECTRIC MATERIALS

Types of polarization: electronic, ionic, orientation and space charge polarization mechanisms - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric strength and loss -dielectric breakdown mechanisms - active dielectric materials: pizo, pyro and ferroelectricity - applications.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Interaction of light with materials - optical absorption - transmission - Luminescence in solids - Fluorescence and Phosphorescence - Optical band gap - LED ,LCD.

UNIT V **8 Hours**

MAGNETIC MATERIALS

Classification and properties - domain theory - hard and soft magnetic materials - anti-ferro and ferri magnetic materials - applications: magnetic recording and memories.

FOR FURTHER READING

Photonic crystals - LIFI

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

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

4 **4 Hours**

EXPERIMENT 3

With the aid of travelling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13th revised edition, Meerut, India, 2013.
2. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
3. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
4. M.A. Wahab, N.K. Mehta, Solid state physics-structure and properties of materials, Narosa publishing house Pvt. Ltd, 6th edition, 2010.
5. Semiconductor Physics and Devices, Donald A. Neamen , Mc Graw-Hill, 2011.
6. P.K. Palanisamy, Materials Science, Scitech Publications India Pvt. Ltd, 2014.

15PH202 APPLIED PHYSICS 3 0 2 4

Course Objectives

- To understand conducting, semiconducting, dielectric and magnetic properties of materials and exemplify their applications
- To analyze the basic concepts of thermodynamics and heat transfer with illustrations
- To gain knowledge about acoustical standards of buildings

Programme Outcomes (POs)

a. 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.
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. Analyze the physical properties of conducting and semiconducting materials
2. Discuss the physical properties of dielectric and magnetic materials with their applications
3. Apply the thermodynamic processes and laws to compute the efficiency of heat engines
4. Compare the different heat transfer modes with real time applications of conduction
5. Explain the characteristics of music and select proper sound absorbing materials for good acoustic of buildings

Articulation Matrix

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

UNIT I **11 Hours**

CONDUCTORS AND SEMICONDUCTORS

Conductors: Classical free electron theory - electrical and thermal conductivity- Wiedemann - Franz law - merits and demerits of classical free electron theory - band theory - density of states. Semiconductors: Elemental and compound semiconductors - intrinsic semiconductors -Fermi level and electrical conductivity - band gap energy - extrinsic semiconductors - n-type and p-type semiconductors: variation of Fermi level with temperature (qualitative) - Hall effect - applications.

UNIT II **9 Hours**

DIELECTRIC AND MAGNETIC MATERIALS

Dielectrics: Fundamental terminologies - electronic and ionic polarizations - orientation polarization mechanism (qualitative) - space charge polarization - Langevin -Debye equation - dielectric loss - applications of dielectric and insulating materials. Magnetic Materials: Properties of dia, para and ferromagnetic materials - domain theory of ferromagnetism - hysteresis curve - hard and soft magnetic materials - applications

UNIT III **9 Hours**

THERMODYNAMICS

Zeroth law of thermodynamics - Heat - equilibrium and quasistatic process - path functions -comparison between heat and work - internal energy - first law of thermodynamics - isothermal and adiabatic process - work done - reversible and irreversible process - second law of thermodynamics - entropy - enthalpy - Carnot ideal engine and its efficiency - Carnot's theorem-actual heat engine: Diesel engine and its efficiency

UNIT IV **9 Hours**

HEAT TRANSFER

Modes of heat transfer - thermal conductivity - heat capacity and diffusivity - rectilinear flow of heat - conduction through bodies in series and parallel - determination of thermal conductivity: good conductor: Searle's method - bad conductor: Lee's disc method - applications of heat transfer: formation of ice in ponds - conductivity of earth's crust and age of earth - practical applications

UNIT V **7 Hours**

ACOUSTICS

Classification of sound based on frequency - characteristics of audible sound - reverberation time: Sabine's formula - determination of absorption coefficient - Erying's formula (qualitative). Sound insulation - sound absorbing materials - factors affecting the acoustics of building - remedies

FOR FURTHER READING

Nanomaterials and its applications

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

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

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons,Inc, 2010
2. BrijLal, N. Subrahmanyam and P. S. Hemne, Heat, Thermodynamics & Statistical Physics, S. Chand & Company Ltd., New Delhi, 2012
3. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13threvised edition, Meerut, India, 2013
4. P.K. Mittal, Applied Physics, I.K. International Publishing House Pvt. Ltd, 2008
5. Donald A. Neamen, Semiconductor Physics and Devices,McGraw-Hill, 2011

3 0 2 4

15PH203 MATERIALS SCIENCE

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To impart fundamental knowledge in optical materials
- To understand the nature and applications of different magnetic materials

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Distinguish electrical properties of different kinds of conducting materials
2. Identify the different types of semiconductors and its applications
3. Categorize the various polarization mechanisms in dielectrics
4. Choose the suitable material for the construction of display devices
5. Select appropriate magnetic materials for magnetic storage devices

Articulation Matrix

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

UNIT I **8 Hours**

ELECTRICAL PROPERTIES OF METALS

Quantum free electron theory: Fermi-Dirac distribution function - Fermi energy and its variation with temperature - density of energy states - calculation of density of electrons and fermi energy at 0K - mean energy of electrons at 0K - problems.

UNIT II **10 Hours**

SEMICONDUCTING MATERIALS

Introduction - elemental and compound semiconductors - intrinsic semiconductors: expressions for number of electrons and holes - determination of carrier concentration and position of Fermi energy - electrical conductivity - band gap energy determination - carrier concentration in extrinsic semiconductors. Hall effect: theory and experimental determination - uses - problems.

UNIT III **9 Hours**

DIELECTRICS

Introduction - fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin - Debye equation - frequency and temperature effects on polarization - internal field - expression for internal field (cubic structure) - Clausius-Mosotti equation and its importance - applications of dielectric materials - problems.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Introduction - optical absorption in metals, semiconductors and insulators. Fluorescence and phosphorescence. Light emitting diode: principle, construction, working and applications. Liquid crystal display: general properties - dynamic scattering display - twisted nematic display - applications - comparison between LED and LCD. Blue ray disc - principle - working.

UNIT V **9 Hours**

MAGNETIC MATERIALS

Introduction - orbital and spin magnetic moments - Bohr magneton - basic definitions - classification of magnetic materials - domain theory of ferromagnetism - process of domain magnetization - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials.

FOR FURTHER READING

Optical data storage and Giant magnetoresistance

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

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

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons, Inc, 2010.

2. S.O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2014.
3. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
4. P.K. Palanisamy, Physics For Engineers, Scitech Publications (India) Pvt. Ltd., Chennai, 2010.
5. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, New Delhi, 2010.
6. R.K.Gaur and S.L.Gupta, Engineering Physics, Dhanpat Rai publications, New Delhi, 2010.

Assessment Pattern

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

Assessment Questions

Remember

1. Define density of electron energy states in metals.
2. Recall Fermi energy.
3. State Hall Effect.
4. List out the four advantages of semiconductors.
5. Define dielectric constant
6. Recall electric polarization.
7. Define Fluorescence.
8. Recognize hard and soft magnetic materials.
9. State the working principle of LED.
10. Define Bohr magnetron.

Understand

1. Classify three types of free electron theory
2. Represent the variation of Fermi level with temperature
3. Explain Clausius-Mosotti relation.
4. Compare element and compound type semiconductors.
5. Illustrate the variation of Fermi level with temperature in n-type semiconductors.
6. Distinguish between a dielectric and insulator.
7. Mention the technique to increase the emission time in phosphorescence.
8. Exemplify hysteresis on the basis of domain theory of ferromagnetism.
9. Identify four examples for hard magnetic materials.
10. Identify four properties of ferromagnetic materials.

Apply

1. Compute the Fermi direc function for energy kT above the Fermi energy.
2. Asses the Fermi-Dirac distribution function.
3. Energy level of p-type and n-type semiconductors and justify the results
4. Compute the carrier concentration of intrinsic semiconductors
5. Explain the principle, construction and working of Hall Effect
6. Show that electronic and ionic polarizabilities are independent of temperature.
7. Calculate the polarization of an atom above value five.

8. Differentiate the dia, para and ferromagnetic materials.
9. Compute the B-H Hysteresis curve on the basis of domain theory.

Analyse

1. Discriminate drift velocity and thermal velocity of an electron
2. Difference between p-type and n-type semiconductors.
3. Obtain the expression for concentration of charge carriers in p-type semiconductor.
4. In practical dielectrics, the current does not exactly lead the voltage by 90?. Justify.
5. Local field is the space and time average of the electric field acting on a particular molecule Justify the result.
6. Justify the special features of magnetic blue ray disks.
7. Analyze the role of energies in the domain growth.
8. Explain the roll of activators in optical materials
9. Describe the working of twisted pneumatic display device.
10. Compare LED and LCD.

15PH204 PHYSICS OF ENGINEERING MATERIALS 3 0 2 4

Course Objectives

- To familiarize with the physical properties of materials
- To gain practical applications of modern spectroscopy and microscopy techniques
- To understand the preparation of bio and nanomaterials

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. identify the electrical and thermal properties of conducting and semiconducting materials
2. analyze the various polarization mechanisms in dielectrics
3. choose specific materials for optical and magnetic data storage devices
4. investigate the specimen with the aid of suitable spectroscopic techniques
5. realize the methods adopted for preparing nano materials

Articulation Matrix

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

UNIT I **10 Hours**

CONDUCTING AND SEMICONDUCTING PROPERTIES

Quantum free electron theory - Fermi-Dirac distribution function - effect of temperature on Fermi function - density of energy states - calculation of density of electrons and Fermi energy at 0 K. Intrinsic semiconductors: expressions for density of electrons and holes - intrinsic carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in n-type and p-type semiconductors - variation of Fermi level with temperature and impurity concentration - problems.

UNIT II **9 Hours**

DIELECTRIC PROPERTIES

Introduction: fundamental definitions in dielectrics - types of polarization - expressions for electronic and ionic polarization mechanisms - orientation polarization (qualitative) - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric loss - dielectric breakdown mechanisms - active dielectric materials - applications of dielectric materials - problems.

UNIT III **10 Hours**

OPTICAL AND MAGNETIC PROPERTIES

Optical properties: introduction - light interaction with solids - atomic and electronic interactions - optical properties of metals, semiconductors and insulators - reflection - refraction - absorption - transmission - luminescence and photoconductivity. Magnetic properties: introduction - origin of magnetic moment - properties of dia, para and ferro magnetic materials - domain theory and hysteresis effect - hard and soft magnetic materials - problems.

UNIT IV **8 Hours**

SPECTROSCOPY AND MICROSCOPY TECHNIQUES

Introduction: different types of spectroscopy techniques - basic principle of FTIR spectroscopy and X-ray Photoelectron Spectroscopy (XPS). Basic principle and working mechanisms of Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - Atomic Force Microscope (AFM).

UNIT V **8 Hours**

BIO AND NANO MATERIALS

Biomaterials: classification of biomaterials - development of biomaterials - applications. Nanomaterials: properties - synthesis of nanomaterials - top-down approach: ball milling technique - bottom-up approach: Chemical Vapour Deposition (CVD) - uses of nanomaterials. Carbon nanotubes: properties and applications.

FOR FURTHER READING

Health and environmental impacts

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

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

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering An Introduction, John Wiley and Sons, Inc, 2010.
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
3. Jacob Milliman, Christos Halkias, Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
4. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
5. Subbiah Pillai, Nanobiotechnology, MJP Publishers, 2010.
6. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley-VCH, 2013.

Assessment Pattern

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

Assessment Questions

Remember

1. Recall the merits of quantum free electron theory over classical free electron theory
2. Define carrier concentration
3. Recall Fermi energy
4. List the four types of polarization mechanisms.
5. Recognize polar and non-polar molecules
6. Define Bohr magneton
7. Recall coercivity and retentivity
8. Point out the four salient features of biomaterials
9. Define bioactive materials
10. State the working principle of FTIR spectroscopy

Understand

1. Classify three types of materials based on bandgap energy
2. Explain fermi-distribution function and effect of temperature on Fermi function
3. Represent the variation of Fermi level with temperature
4. Explain intrinsic and thermal breakdown mechanisms
5. Infer the importance of Fermi level in a semiconductor
6. Illustrate the phenomenon of B-H hysteresis on the basis of domain theory
7. Classify four types of biomaterials
8. Represent the scanning electron microscope to determine the grain size of the nanomaterials
9. Explain the principle, construction and working of Scanning electron microscope
10. Explain the principle and working mechanism of X – ray photoelectron spectroscopy (XPS)

Apply

1. Find the variation of Fermi level with temperature and impurity concentration in n-type semiconductors
2. Show that electronic and ionic polarizabilities are independent of temperature
3. Show that the position of Fermi level is exactly at the midpoint of forbidden energy gap in intrinsic semiconductor
4. Compute the relationship between polarizability and electric flux density.
5. Assess the properties of dia, para and ferromagnetic materials
6. Show that top down method is inferior to bottom up method
7. Construct B-H Hysteresis curve on the basis of domain theory
8. Design the principle, construction and working of chemical vapour deposition.
9. Show that the electronic polarizability is directly propotional to the volume of an atom
10. Compute the expression for carrier concentration in intrinsic semiconductors

Analyse

1. Extrinsic semiconductors possess high electrical conductivity than intrinsic semiconductors. Justify
2. Silver is the best conductor of electricity. But gold is used in high-end electronic connectors. Justify.
3. Identify the role of impurity concentration in the variation of Fermi level in the case of p-type semiconductors.
4. Compare polar dielectrics with non-polar dielectrics.
5. Analyse the features of hard and soft magnetic materials.
6. Compare the six properties of dia, para and ferro magnetic materials
7. Differentiate top down approach from bottom up approach.
8. Select the four important features of TEM
9. Justify the electronic polarizability of Argon is much greater than that of Helium.
10. Intrinsic semiconductors are insulators at 0K. Justify.

15PH205 SOLID STATE PHYSICS 3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To understand the working mechanism of junction diodes
- To impart knowledge in optical and magnetic materials

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. identify different types of emission of electrons and significance of Fermi function
2. explore the carrier concentration and its variation with temperature of different semiconducting materials
3. analyze the I-V characteristics of a junction diode
4. investigate the various polarization mechanisms in dielectrics
5. select appropriate optical and magnetic materials for data storage devices

Articulation Matrix

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

UNIT I 10 Hours

EMISSION PROPERTIES AND QUANTUM THEORY OF SOLIDS

Emission of electrons: types thermionic emission-principle- Richardson equation- secondary emission-principle- work function- Fermi-Dirac distribution function and its temperature dependence significance of Fermi energy- density of energy states- calculation of density of electrons and Fermi energy at 0K- average energy of electrons at 0K problems.

UNIT II 9 Hours

SEMICONDUCTOR PHYSICS

Intrinsic semiconductors: the law of mass action - expressions for density of electrons and holes - determination of carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in p-type and n-type semiconductors. Hall effect: theory - experimental determination of Hall voltage - applications - problems.

UNIT III 9 Hours

JUNCTION DIODE CHARACTERISTICS

Introduction - pn junction diode - volt-ampere characteristics - diode current equation - static and dynamic resistances - space charge - diffusion capacitance - junction diode switching times. Diode circuit with DC voltage source. Applications: full wave rectifier - capacitor filters - clamper circuits.

UNIT IV **9 Hours**

DIELECTRICS

Introduction: fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin Debye equation - frequency and temperature effects on polarization - expression for internal field (cubic structure) - Clausius-Mosotti equation - dielectric loss - applications of dielectrics - problems.

UNIT V **8 Hours**

OPTOELECTRONICS AND MAGNETIC MATERIALS

Principle, working and characteristics of LED and LCD - blue ray disc. Magnetic materials: basic definitions - properties of dia, para and ferro magnetic materials - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials. Magnetic storage device: principle - working - giant magnetoresistance.

FOR FURTHER READING

Motion of an electron in uniform and non-uniform magnetic fields - electric and magnetic fields in a crossed configuration.

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

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

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Jacob Millman, Christos Halkias and Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
2. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and sons, Inc, 2010.
3. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
4. R. S. Sedha, A textbook of Applied Electronics, S. Chand & Company Ltd., New Delhi, 2010.
5. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010
6. M. N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.

Assessment Pattern

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

Assessment Questions

Remember

1. Recall the Richardson equation.
2. Define dynamic resistance.
3. State the law of mass action.
4. Define Hall Effect.
5. List the three practical applications of p-n junction diode.
6. List the three practical applications of p-n junction diode.
7. List the four types of polarizations in dielectrics
8. Reproduce the expressions for electronic and ionic polarization.
9. State the working principle of LED.
10. Define retentivity and coercivity.

Understand

1. Explain the variation of Fermi-Dirac distribution function with temperature.
2. Indicate the importance of Fermi level.
3. Indicate the reason for preferring extrinsic semiconductors over intrinsic semiconductors.

4. Represent four applications of Hall Effect.
5. Represent the switching action of a diode.
6. Interpret the relation between polarization and polarisability in dielectrics.
7. All the dielectrics are insulators but all the insulators are not dielectrics. Illustrate with examples.
8. Interpret the relation between the dielectric constant and electric susceptibility.
9. Explain the phenomenon of electroluminescence in LED.
10. Summarize the working principle of giant magnetoresistance.

Apply

1. Find the expression for density of electrons and Fermi energy at 0 K.
2. Using the Fermi function, compute the temperature at which there is 1% probability that an electron in a solid will have energy 0.5 eV above EF of 5 eV.
3. Explain how phosphorous atoms donate electrons to the conduction band.
4. Apply the law of mass action to determine the carrier concentration of intrinsic semiconductors.
5. Construct a circuit using p-n junction diode and execute its V-I characteristics.
6. Construct a diode circuit with DC voltage source and demonstrate its working conditions.
7. Show that electronic polarizability is independent of temperature.
8. Explain frequency dependence of dielectrics with a neat sketch.
9. Apply the domain theory to the hysteresis effect observed in ferromagnetic materials.
10. Compute the wavelength of light emitted by an LED with band gap energy of 1.8 eV.

Analyse

1. The average energy of electrons at 0 K depends on Fermi level. Justify.
2. Differentiate p-type and n-type semiconductors.
3. Outline the working principle of full wave bridge rectifier.
4. At optical frequencies the total polarization is less. Justify.
5. Outline the causes for dielectric loss in dielectric materials.
6. Analyze the magnetic behavior of dia, para and ferromagnetic materials.
7. Compare the properties of LED and LCD.
8. Outline the difference between hard and soft magnetic materials.

Evaluate

1. Evaluate the resistance value using V-I characteristics of a p-n junction diode.
2. Evaluate the value of Fermi distribution function for an energy kT above the Fermi energy at that temperature and comment on the answer.

CHEMISTRY ELECTIVES **3 0 2 4**

15CH201 ENGINEERING CHEMISTRY

Course Objectives

- Recall the terminologies of electrochemistry and explain the function of batteries and fuel cells with its electrochemical reactions
- Understand the fundamentals of corrosion, its types and polymers with its applications
- Choose appropriate instrumentation technique for interpreting analytical data

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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.

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

Course Outcomes (COs)

1. Construct an electrochemical cell and measure its potential using selected reference electrode
2. Identify the electrodes, electrolyte and cell reactions in batteries, fuel cells and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion control method
4. Differentiate polymers based on its source, properties and applications
5. Select suitable analytical method for the estimation of alkali and alkaline earth metals in aqueous media

Articulation Matrix

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

UNIT I **10 Hours**

INTRODUCTION TO ELECTROCHEMISTRY

Types of electrodes - electrode potential - salt bridge - cell reaction - cell representation - silver-silver chloride electrode - calomel electrode - determination of single electrode potential - electrochemical series and its importance. Ion-selective electrode: glass electrode - measurement of pH using glass electrode. Concentration cells (electrode and electrolyte). Potentiometry - potentiometric titrations (redox titration). Difference between electrochemical and electrolytic cells

UNIT II **9 Hours**

ENERGY STORAGE DEVICES

Batteries - characteristics of battery - types of batteries.construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Comparison with conventional galvanic cells. Fuel cells - Types of fuel cells: solid polymer electrolyte fuel cell - solid oxide fuel cells - microbial fuel cell. Hydrogen-oxygen fuel cell - construction, working, advantages and limitations

UNIT III **8 Hours**

CORROSION SCIENCE

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion - Pilling-Bedworth ratio - types of oxide layer (stable, unstable, volatile and porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current cathodic protection method - electroplating - electroless plating

UNIT IV **10 Hours**

POLYMERS AND ITS PROCESSING

Advantages of polymers over metals. Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications - Molecular weight determination. Types of polymerization: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (polyvinyl chloride and polytetrafluoroethylene). Compounding of plastics - injection and extrusion moulding methods

UNIT V **8 Hours**

INSTRUMENTATION TECHNIQUES FOR CHEMICAL ANALYSIS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: UV-visible spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of a transition metal) - Flame photometry (estimation of an alkali metal)

FOR FURTHER READING

Nobel prize winners in chemistry over past 5 years

1 **2 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and M/10 sodium carbonate solution.

2 **2 Hours**

EXPERIMENT 2

Determination of strength of hydrochloric acid present in the given solution by pH measurement.

3 **2 Hours**

EXPERIMENT 3

Determination of strength of HCl by conductometric titration.

4 **2 Hours**

EXPERIMENT 4

Conductometric titration of mixture of acids (Hydrochloric acid and acetic acid).

5 **2 Hours**

EXPERIMENT 5

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

6 **2 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on zinc/mild steel in aerated neutral/acidic/alkaline solution by weight loss method.

7 **2 Hours**

EXPERIMENT 7

Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

8 **2 Hours**

EXPERIMENT 8

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

Total: 61 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008.
5. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.

15CH202 APPLIED CHEMISTRY 3 0 2 4

Course Objectives

- Understand the necessity of water softening processes
- Aware the causes and consequences of corrosion
- Acquaint the applications of alloying and phase rule in metallurgy
- Recognise the fundamentals and applications of fuels
- Characterize the chemical compounds using analytical techniques.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Analyze the type of corrosion, factors influencing rate of corrosion on metals and corrosion control methods
3. Differentiate ferrous and non ferrous alloys based on its properties, applications and illustrate the importance of phase rule in the field of mettallurgy
4. Distinguish the three types of fuels based on calorific value for selected applications
5. Apply suitable analytical methods for the estimation of elements in aqueous media

Articulation Matrix

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

UNIT I **10 Hours**

WATER PURIFICATION

Hardness of water - classification of hardness (temporary and permanent) - units of hardness (ppm, mg/l, degree Clark, degree French) - expression of hardness in terms of calcium carbonate equivalence - estimation of hardness by EDTA Method - Uses of water for industrial purpose - requirements of boiler feed water - disadvantages of using hard water in industrial boilers: scale, sludge, priming, foaming and caustic embrittlement. Removal of dissolved salts from hard water: internal conditioning (phosphate, carbonate, calgon and colloidal methods), external conditioning (ion exchange process, reverse osmosis, electrodialysis). Uses of water for domestic purpose - municipal water treatment (screening, aeration, coagulation, sedimentation, filtration and disinfection of water - break point chlorination).

UNIT II **8 Hours**

CORROSION SCIENCE

Corrosion - chemical and electrochemical corrosion - Pilling-Bedworth rule - mechanism (types of oxide layer, oxygen absorption - hydrogen evolution) - Galvanic series -types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline and waterline)-Factors influencing corrosion (nature of metal and environment). Corrosion control: sacrificial anode - impressed current method.Protective coatings - paint -constituents and functions.

UNIT III **9 Hours**

ALLOYS AND PHASE RULE

Alloys: purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys. Ferrous alloys: nichrome and stainless steel. Non-ferrous alloys: brass and bronze. Heat treatment of alloys (annealing, hardening, tempering, normalising, carburizing and nitriding). Phase rule: phase - component - degree of freedom - phase rule - phase diagram - applications- one component system (water system). Reduced phase rule - two component system (lead and silver system).

UNIT IV **10 Hours**

FUELS

Classification - characteristics - calorific value - solid fuel - coal - types - analysis of coal (proximate and ultimate analysis) - processing of coal to coke - carbonization - types (low temperature and high temperature carbonization) - manufacture of metallurgical coke (Otto Hoffmann method). Liquid fuels - petroleum - refining of crude oil - knocking - octane number - cetane number. Liquid fuel from coal (Bergius process). Gaseous fuels - natural gas (CNG) - coal gas - producer gas - syn gas - shale gas.

8 Hours

UNIT V

INSTRUMENTAL METHODS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - Infrared spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of transition metal) - Flame photometry (estimation of alkali metal).

FOR FURTHER READING

Synthesis and applications of bio-fuels.

1 **2 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and N/10 sodium carbonate solution.

2 **4 Hours**

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH.

3 **4 Hours**

EXPERIMENT 3

Conductometric titration of mixture of acids (HCl CH3COOH).

4 **4 Hours**

EXPERIMENT 4

Determination of strength of hydrochloric acid in a given solution using pH meter.

5 **4 Hours**

EXPERIMENT 5

Determination of the strength of Fe(II) in the given sample by potentiometric method.

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on mild steel in aerated / neutral / acidic / alkaline medium by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Estimation of copper content in brass by EDTA method.

8 **4 Hours**

EXPERIMENT 8

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

Total: 75 Hours

Reference(s)

1. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.

2. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
3. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.
4. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishers New Delhi, 16th Edition, 2013.
5. R. Mukhopadhy and S. Datta, Engineering Chemistry, New age international Pvt. Ltd, New Delhi, 2010.
6. Shashi Chawla, Engineering Chemistry, Dhanpat Rai Publishers New Delhi, 2nd Edition, 2003.

15CH203 APPLIED ELECTROCHEMISTRY 3 0 2 4

Course Objectives

- Understanding the basic concepts of electrochemistry and their application
- Expanding knowledge about corrosion and methods of control
- Gaining information regarding principle, working and application of batteries and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Construct an electrochemical cell and calculate its cell potential.
2. Measure the emf of a cell using different electrodes.
3. Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.
4. Differentiate types of corrosion and its prevention by suitable techniques.
5. Recognize the importance of fuel cells and solar battery.

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTALS OF ELECTROCHEMISTRY

Introduction - electrical conductance in solution - electrical double layer - electrode potential - importance of electrode potential. Electrochemical cell - standard cell: Weston cadmium cell - Concentration cell: electrode and electrolyte - applications. Applications of electrolytic cells: electrolysis of water, electrolysis of brine and electroplating of copper and gold

UNIT II **9 Hours**

REFERENCE ELECTRODES

Primary and secondary reference electrodes - metal-metal ion electrode, metal-metal insoluble salt electrodes: silver-silver chloride electrode, calomel electrode - ion-selective electrode: glass electrode - measurement of pH of a solution using glass electrode. Quinhydrone electrode: construction - advantages - limitations. Applications of EMF measurements: Potentiometric titrations: acid-base titration - oxidation-reduction titration - precipitation titration

UNIT III **10 Hours**

ENERGY STORING DEVICES

Types of batteries - alkaline, lead-acid, nickel-cadmium and lithium batteries - construction, working and commercial applications. Electrochemical sensors. Decomposition potential: variation of decomposition potential for different metals - importance of decomposition potential. Over voltage: factors affecting over voltage value. Maintenance and precautions in battery handling

UNIT IV **10 Hours**

CORROSION SCIENCE

Corrosion - causes - dry and wet corrosion - Pilling-Bedworth rule - mechanism (hydrogen evolution and oxygen absorption) - rusting of iron. Galvanic series - applications. Galvanic corrosion - differential aeration corrosion (pitting, waterline and stress) - factors influencing corrosion. Corrosion control - sacrificial anode and impressed current cathodic protection methods - Metallic coatings: chromium plating - nickel plating - galvanizing and tinning

UNIT V **7 Hours**

FUEL CELL AND SOLAR BATTERY

Introduction - types of fuel cell: low, medium and high temperature fuel cell. Hydrogen-Oxygen fuel cell - advantages. Solid polymer electrolyte fuel cell, solid oxide fuel cells, biochemical fuel cell. Solar battery - domestic, industrial and commercial applications. Environmental and safety issues

FOR FURTHER READING

Document the various batteries with its characteristics used in mobile phones and laptops Maintenance free batteries, Battery recycling

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions.

2 **4 Hours**

EXPERIMENT 2

Determination of strength of a commercial mineral acid by conductometric titration.

3 **4 Hours**

EXPERIMENT 3

Electroplating of copper onto a stainless steel object.

4 **4 Hours**

EXPERIMENT 4

Determination of strength of iron in a given solution by potentiometric method.

5 **4 Hours**

EXPERIMENT 5

Determination of amount of hydrochloric acid present in the given sample using pH meter.

6 **4 Hours**

EXPERIMENT 6

Conductometric titration of mixture of acids.

7 **4 Hours**

EXPERIMENT 7

Determination of corrosion inhibition on mild steel using natural inhibitors.

8 **4 Hours**

EXPERIMENT 8

Estimation of barium by precipitation titration.

Total: 75 Hours

Reference(s)

1. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010.
2. B. S. Chauhan, Engineering Chemistry, 3rd Edition, Laxmi Publication Ltd, New Delhi, 2010.
3. B. R. Puri, L. R. Sharma and Madan S Pathania, Principles of physical chemistry, 46th Edition, Vishal publishing Ltd, New Delhi, 2013.
4. B. S. Bahl, G. D. Tuli and Arun Bahl, Essentials of Physical Chemistry, 5th Edition, S. Chand & Company, New Delhi, 2012.
5. S. Vairam, Engineering Chemistry, 1st Edition, John -Willy, India private limited, New Delhi, 2014.
6. Sashi Chawla, Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			2	1	1			2	1		1	1	2			2	1			1	1		20
2	1	4			2	4	1			2			1	2				1	2						20
3		1	1		4	5			2	4			2	1			1	2							23
4	2	1			2	5	1			3				2			2	2				2			22
5	2	2			1	4			2	1			1	1				1							15
																								Total	100

Assessment Questions

Remember

1. List any two advantages of hydrogen oxygen fuel cells.
2. Name any two secondary batteries used in electronic appliances.
3. State pilling bedworth rule.
4. List any two applications of lithium battery.
5. Define overvoltage.

6. Recall the two limitations of quinhydrone electrode.
7. List the three major applications of galvanic series.
8. Recall the term redox reaction.
9. Define standard electrode potential.

Understand

1. Identify any two factors affecting the rate of corrosion based on the nature of metal.
2. Compare solar battery with lead acid-battery with respect to cell reactions, advantages and limitations.
3. Explain the working of hydrogen-oxygen fuel cell with necessary diagram and cell reactions. Mention its two advantages and limitations.
4. Identify the four advantages of electroless plating over electroplating.
5. Explain the difference between galvanic and differential aeration corrosion with an example each.
6. Summarize any five factors that affect overvoltage value of a cell.
7. Differentiate cell from battery.
8. Sketch and explain the construction and working of saturated calomel electrode with necessary cell reactions.
9. With a neat sketch explain the working of a silver – silver chloride electrode.
10. Elucidate the working principle of Weston cadmium cell with suitable cell reactions.
11. Distinguish galvanic and electrolytic cells based on cell reactions.

Apply

1. Assess the six advantages of solid polymer electrolyte fuel cell.
2. Many metals form oxide layer when exposed to atmospheric conditions due to corrosion. Predict the four types of metal oxide layers formed with two examples each.
3. An iron pipe line buried under soil is used to carry natural gas, suggest any two corrosion control techniques that can be employed to minimize/control corrosion.
4. Predict the type of corrosion taking place when a piece of iron rod is exposed to moisture and explain the mechanism of rust formation.
5. Illustrate the construction of 6V lead-acid battery and explain its functioning during discharging and charging process.
6. Select a suitable secondary storage battery used in mobile phones. Explain its reactions during charging and discharging process.
7. Find the electrode potential of zinc rod using saturated calomel electrode as reference electrode (E cell value is 1.10 V).
8. Apply the principle of ion selective electrode to find the pH of HCl solution using glass electrode with necessary equations.
9. Can we use KCl salt bridge to construct a cell using Ag and Pb half-cell. Give reason.
10. Identify a suitable technique to achieve copper coating on stainless steel object with a neat diagram.

Analyse

1. Can you store zinc sulphate solution in a copper container? Give reason if your answer is yes/no.
2. Predict why copper cannot displace hydrogen from mineral acid solution.
3. Compare a deep cycle battery and a starting battery based on its application.
4. Zinc corrodes at a faster rate when coupled with copper than lead. Give reason.
5. Does the water exhaust from hydrogen - oxygen fuel cell is drinkable? Give reasons if Yes/No.

Evaluate

1. Electrode potentials of A and B are E0A/A+ = +0.76 V and E0B/B+ = -0.34 V respectively. Choose the appropriate anode half-cell and cathode half-cell by giving the cell representation.
2. Glass electrode cannot be used in solutions having pH greater than 9.0. Give reason.
3. The standard reduction potentials of metals Ag, Fe, Cu and Zn are +0.80v,-0.44v, +0.34v and -0.76v respectively. Arrange the metals in the increasing order of their ability to undergo corrosion.

4. Identify any two advantages of microbial fuel cell over lead acid battery.
5. Represent diagrammatically an electrochemical cell that produces 1.1 volt as an output. Write the half-cell reactions responsible for that.

Create

1. As an engineer, which type of metal oxide forming metal you will choose for your design? Reason out.
2. Derive the probable reason and possible solution for the following:
   i) Stainless steel should not be used to build ship hull.
   ii) Small anodic area results in intense corrosion.
   iii) Metal under water drop undergoes accelerated corrosion.

3 0 2 4

15CH204 INDUSTRIAL CHEMISTRY

Course Objectives

- Impart knowledge on the principles of water characterization, treatment methods and industrial applications
- Understand the principles and application of electrochemistry, fuel and combustion
- Recognize the fundamentals of polymers, nano chemistry and analytical techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Identify the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Utilize the concepts of electrochemistry in real time applications.
3. Realise the importance of fuel chemistry in day to day life.
4. Differentiate the polymers used in day to day life based on its source, properties and applications
5. Familiarize with the synthesis and characterization techniques of nanomaterials.

Articulation Matrix

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

Course Outcomes (COs)

1. Identify the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Utilize the concepts of electrochemistry in real time applications.
3. Realise the importance of fuel chemistry in day to day life.
4. Differentiate the polymers used in day to day life based on its source, properties and applications
5. Familiarize with the synthesis and characterization techniques of nanomaterials.

UNIT I **10 Hours**

WATER PURIFICATION TECHNOLOGY: SOFTENING AND DESALINATION

Hardness of water: Equivalents of calcium carbonate - Units of hardness - Degree of hardness and estimation (EDTA method). Use of water for industrial purposes: Boiler feed water-scale-sludge -priming and foaming -caustic embrittlement. Softening of hard water: External conditioning - ion exchange methods - Internal conditioning - trisodium, dihydrogen, trihydrogen phosphate and sodium hexameta phosphate- carbonate- colloidal methods. Desalination: Reverse osmosis - electrodialysis. Domestic water treatment - Disinfection of water - break point chlorination

UNIT II **10 Hours**

ELECTROCHEMISTRY

Introduction - EMF - Single electrode potential -Calomel electrode - Glass electrode -pH measurement using glass electrode - Electrochemical series. Cells: Electrochemical cells - Cell reactions- Reversible cells and irreversible cells. Batteries - characteristics of battery - types of batteries, construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Fuel cell: Hydrogen - Oxygen fuel cell.Electroplating of copper and electroless plating of nickel

UNIT III **8 Hours**

FUELS AND COMBUSTION

Fuel: Introduction - classification of fuels - calorific value - higher and lower calorific values - analysis of coal (proximate and ultimate) - carbonization - manufacture of synthetic petrol (Bergius process) - knocking - octane number - cetane number - natural gas - Compressed Natural Gas (CNG)- Liquefied Petroleum Gases (LPG) - producer gas - water gas. Combustion of fuels: introduction- theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - ignition temperature

UNIT IV **9 Hours**

POLYMER AND COMPOSITES

Monomers - functionality - degree of polymerizations - classification of polymers based on source and applications; porosity - tortuosity - molecular weight determination by Ostwald method - polymerization methods: addition, condensation and copolymerization - mechanism of free radical polymerization - thermosetting and thermoplastics. Polymer blends - composites, significance, blending-miscible and immiscible blends, phase morphology, fibre reinforced plastics, long and short fibre reinforced composites

UNIT V **8 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire -nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production

- properties - applications. Working principle and applications - Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV-Visible spectrophotometer

FOR FURTHER READING
Application of nanomaterials in medicine, environment, energy, information and communication sectors

1 **2 Hours**

EXPERIMENT 1
General instructions to students - Handling reagents and safety precautions

2 **4 Hours**

EXPERIMENT 2
Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH

3 **4 Hours**

EXPERIMENT 3
Determination of strength of hydrochloric acid in a given solution using pH meter

4 **4 Hours**

EXPERIMENT 4
Determination of strength of a commercial mineral acid by conductometric titration

5 **4 Hours**

EXPERIMENT 5
Conductometric titration of mixture of acids

6 **4 Hours**

EXPERIMENT 6
Determination of the strength of iron in the given sample by potentiometric method

7 **4 Hours**

EXPERIMENT 7
Determination of molecular weight of polyvinyl alcohol by Ostwald viscometry method

8 **4 Hours**

EXPERIMENT 8
Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008
5. G. Cao, Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific, New Jersey, 2011
6. S. Sarkar, Fuels and combustion, 3rd edition, Orient Longman Ltd. New Delhi, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	1	1		2	4	3			1	3		1		3				1						21
2	2	1	2		2	5	2		1	1	3				1				1						21
3	1	2	2		1	3	3			2	2			1	1				1						19
4	1	1	1		3	4	1		1	1	3			1	2				1						20
5	1	1	1		1	2	2			2	3			2	2				2						19
																								Total	100

Assessment Questions

Remember

1. Define the term break point chlorination.
2. Name a method to prevent the scale formation in the industrial boilers.
3. Define single electrode potential of an electrode.
4. List any two advantages of H2-O2 fuel cell.
5. Define functionality of a monomer.
6. Name any two thermoplastic and thermosetting polymers.
7. List any two applications of SEM.
8. Recall any two application of X-Ray diffractometer.
9. List three factors which affect the standard electrode potential of cell.

Understand

1. Distinguish between alkaline and non alkaline hardness.
2. Identify two significances of RO method in water treatment.
3. Illustrate any three applications of electrochemical series.
4. Identify the reasons for change of properties of materials at nanoscale.
5. Summarize the four applications of calorimeter.
6. Explain the components of TEM with a neat sketch.
7. Compare bottom up approach with top down approach of nanoparticle synthesis.
8. Indicate any two advantages of water gas over producer gas.
9. Differentiate between thermoplastic and thermosetting plastics.
10. Compare nanocluster with nanocrystal.
11. Why copper cannot displace hydrogen from mineral acid solution?

Apply

1. A water sample contains 204 mgs of CaSO4 and 73 mgs of Mg(HCO3)2 per litre. Calculate the total hardness in terms of CaCO3 equivalence.
2. 100 ml of sample water has hardness equivalent to 12.5ml of 0.08N MgSO4. Calculate hardness in ppm.
3. Find out the single electrode potential of a half cell of zinc electrode dipped in a 0.01M ZnSO4 solution at 25°C? E° Zn/Zn 2+ = 0.763 V, R=8.314 JK-1Mol-1, F= 96500 Coulombs.
4. Calculate the reduction potential of Cu2+/Cu=0.5M at 25°C. E° Cu 2+/ Cu= +0.337V.
5. Find out the weight and volume of air required for the complete combustion of 1 kg of coke.
6. A sample of coal containing 60% C, 6% H, 33% O, 0.5 % S, 0.2% N and 0.3% of ash. Find the gross and net calorific value of coal.
7. Calculate the degree of polymerization of polypropylene having molecular weight of 25200.
8. Apply the principle of ion selective electrode to determine the pH of HCl solution using glass electrode with equations.

Analyse

1. Calgon conditioning is advantageous over phosphate conditioning- reason out.

2. Soft water is not demineralized water whereas demineralized water is a soft water- Jusify.
3. Hydrogen electrode is not generally used for pH measurements – Why?
4. Zinc reacts with dil.H2SO4 to give hydrogen but silver doesn't liberate hydrogen. Give reasons.
5. Good fuel should have low ash content- Give reasons.
6. Sugar is an example of non-electrolyte -Reason out.

Evaluate

1. Hydrogen fuel is an ideal fuel for the future among all other fuels- Justify.
2. Choose a best method for water purification and explain their components.

3 0 2 4

15CH205 WATER TECHNOLOGY AND GREEN CHEMISTRY

Course Objectives

- Imparting the knowledge on the principles of water technology and green chemistry
- Understanding the principles and applications of green technology in water treatments
- Infer the engineering applications of green chemistry in dyes, corrosion engineering and nanotechnology

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Understand the importance of green chemistry with its emergence and development.
2. Realize the designing of safer methodologies for green technology to meet the objectives of green engineering.
3. Identify the type of corrosion and its mechanism which will help to develop the corrosion control methods.
4. Apply suitable technique to extract natural dye from its source.
5. Familiarize with the synthesis and characterization techniques of nanomaterials.

Articulation Matrix

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

UNIT I **9 Hours**

WATER TREATMENT

Water quality parameters - Hardness of water - Disadvantages of hard water - Degree of hardness and its estimation (EDTA method) - Boiler feed water - Boiler troubles: Priming, foaming and caustic embrittlement - Softening of hard water: Internal conditioning: Sodium hexameta phosphate - Phosphate methods; External conditioning: Ion exchange method - Desalination: Reverse osmosis - Electrodialysis. Domestic water treatment - Disinfection of water - Break point chlorination.

UNIT II **8 Hours**

WASTE WATER ANALYSIS

Basic principles and concept of green chemistry - Need of green chemistry in day-to-day life - Scientific areas for practical applications of green chemistry - Industrial effluents - Waste water analysis: Concept of chemical oxygen demand (COD) and biological oxygen demand (BOD) - Removal of trace pollutants in waste water: Membrane Bioreactor (MBR) technology - Wet oxidation method.

UNIT III **10 Hours**

CHEMISTRY OF CORROSION

Corrosion: Mechanism of corrosion - chemical and electrochemical - Pilling-Bedworth rule - oxygen absorption - hydrogen evolution - galvanic series. Types of corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline, water line and wire fence corrosion) - factors influencing corrosion. Methods of corrosion control: choice of metals and alloys - proper designing - cathodic protection (Sacrificial anode method, impressed current method)-modifying the environment. Protective coatings: Concept of electroplating: electroplating (gold and copper) - electroless plating (nickel and copper).

UNIT IV **9 Hours**

NATURAL DYES

Introduction - definition - classification of natural dyes - concept of chromophores and auxochromes - Extraction process of colour component from natural dyes: Aqueous extraction, non-aqueous extraction - Purification of natural dyes: Chromatography techniques - Types - Column chromatography - thin layer chromatography - Qualitative analysis: UV-Visible spectroscopic study - Mordant: Metallic and non-metallic mordant - advantages and disadvantages of natural dyes.

UNIT V **9 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire - nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production - properties - applications. Working principle and applications: Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV- Visible spectrophotometer. Synthesis of Au and Ag nanoparticles using plant extract - Advantages.

FOR FURTHER READING

Protection of metals in concrete against corrosion Microwave technology on green chemistry.

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

2 **4 Hours**

EXPERIMENT 2

Water quality- river/bore well water with respect to hardness and TDS

3 **4 Hours**

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 **4 Hours**

EXPERIMENT 4

Estimation of strength of iron by potentiometric method using calomel electrode

5 **4 Hours**

EXPERIMENT 5

Extraction of a natural dye by aqueous extraction method.

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion of mild steel in aerated neutral/acidic/alkaline solution by weight loss measurements/Tafel polarization method

7 **4 Hours**

EXPERIMENT 7

Determination of dye concentration in a given sample by using UV-Visible spectroscopic method

8 **4 Hours**

EXPERIMENT 8

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

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. V K Ahluwalia, Green Chemistry - Environmentally Benign Reactions, Ane Books Pvt. Ltd., New Delhi, 2nd Edition, 2012
3. Giusy Lofrano, Green Technologies for Wastewater Treatment - Energy Recovery and Emerging Compounds Removal, Springer Dordrecht Heidelberg, New York, London, 2012
4. Ashis Kumar Samanta and Adwaita Konar, Natural Dyes - Dyeing of Textiles with Natural Dyes, Dr.Emriye Akcakoca Kumbasar (Ed.), InTech Publisher, New Delhi, 2011
5. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010
6. David Pozo perez, Nanotechnology and Nanomaterials, InTech Publishers, NewDelhi, 2010.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			3	3				3	3			2	1							1			20
2	2				3	4				2	2			2	1			1							17
3	1	2	1		4	3	3			1	3			1	2			2							23
4	1	2			6	6				3												2			20
5	3	2	2		3	6	2		2																20
																								Total	100

Assessment Questions

Remember

1. List out any four water quality parameters.
2. Name the salts responsible for temporary hardness of water.
3. Recall any two practical applications of green chemistry.
4. Define wet oxidation in waste water treatment.
5. State Pilling Bed-worth′s rule.
6. Recall any two examples for differential aeration corrosion.
7. Name any two natural dyes.
8. Recall the role of auxochromes in dyes.
9. Name the four methods of nanomaterial synthesis.
10. Name any two plant extracts used in silver nanoparticles synthesis.

Understand

1. Hardness of water is always expressed in terms of CaCO3 equivalent. Reason out.
2. Soft water is not demineralized water whereas demineralized water is soft water - Justify.
3. Represent the need of green chemistry in waste water treatment.
4. Indicate the importance of MBR technology in waste water treatment.
5. Express the mechanism of wet corrosion.
6. Bolt and nut made from same metal is preferred in practice. Reason out.
7. Classify the types of natural dyes based on their chemical structure.
8. Compare the properties of metallic and non-metallic mordents.
9. Infer any two important needs of green chemistry in nanotechnology sector.
10. Identify the physicochemical and engineering properties of nanomaterials.

Apply

1. A sample of water contains 180 mgs of MgSO4 per litre. Calculate the hardness in terms of CaCO3 equivalents. (Molecular weight of MgSO4 is 120).
2. Calculate the non-carbonate hardness of a sample of water containing the dissolved salts as given below in mg/l Mg(HCO3)2 = 7.3; Ca(HCO3)2 = 40.5 and NaCl =50.
3. Select the scientific areas for the practical applications of green chemistry.
4. Predict the significance of sacrificial anode in the prevention of corrosion.
5. Execute the principle of electro-deposition to achieve copper coating on stainless steel object with a neat diagram.
6. Select a suitable technique used for the purification of natural dye.
7. Assess the role of Scanning Electron Microscope (SEM) in nano-materials characterization.

Analyse

1. Distinguish between scale and sludge.
2. Identify the four reasons for boiler troubles.
3. Differentiate between BOD and COD.
4. The rate of corrosion increases with increase in temperature. Give reason.

5. Outline the effect of pH of the conducting medium on corrosion.
6. Differentiate chromophores & auxochromes in dyes.

Evaluate

1. Substantiate the statement that nature of the environment affects corrosion.
2. Choose any two best methods to synthesis nanoparticles.

Create

1. Plan and execute a method to get pure water from waste water using available low coast material in your area.
2. Relate the characteristic properties of natural with synthetic dyes.

DISCIPLINE ELECTIVES

15EC001 NANO ELECTRONICS 3 0 0 3

Course Objectives

- To illustrate an introduction to novel nanofabrication techniques and nanoscale device technologies for nanoelectronic applications
- To understand the nanofabrication processes, the design aspect of nanoscale devices will also be addressed
- To organize the current state-of-the-art nanofabrication techniques for nanoelectronic devices as well as basic skills for continuation into advanced design and fabrication

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify the types of nanotechnology and nano machines and properties of nano materials
2. Analyze the dynamic properties of nano electronics
3. Analyze the fundamentals of silicon MOSFET and tecnology scaling in advanced concepts
4. Apply the properties of carbon nano tubes to design memory units and illuminate the synthesis of carbon nanotube
5. Analyze the molecules that can be used for different functions in molecular electronics

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO NANOTECHNOLOGY

Background to nanotechnology: Types of nanotechnology and nano machines ; Molecular Nanotechnology: Electron microscope-scanning electron microscope - atomic force microscope- scanning tunneling microscope- nano manipulator- nano tweezers- atom manipulation- nano dots; Top down and bottom up approaches: self assembly-dip pen nano lithography. Nano materials: preparation- plasma arcing- chemical vapor deposition- sol-gels -electrodeposition ball milling.

UNIT II **9 Hours**

FUNDAMENTALS OF NANOELECTRONICS

Fundamentals of logic devices:- Requirements- dynamic properties- threshold gates; physical limits to computations; concepts of logic devices:- classifications- two terminal devices- field effect devices -coulomb blockade devices- spintronics- quantum dot cellular automata- quantum computing- DNA computer; performance of information processing systems;-Ultimate computation:- power dissipation limit- dissipation in reversible computation.

UNIT III **9 Hours**

SILICON MOSFETS

Silicon MOSFETS - Novel materials and alternate concepts:- fundamentals of MOSFET Devices- scaling rules- silicon-dioxide based gate dielectrics- metal gates- junctions & contacts- advanced MOSFET concepts. Quantum transport devices based on resonant tunneling:- Electron tunneling - resonant tunneling diodes- resonant tunneling devices; Single electron devices for logic applications:- Single electron devices.

UNIT IV **9 Hours**

CARBON NANOTUBES

Carbon Nanotube: Fullerenes - types of nanotubes-formation of nanotubes- assemblies -purification of carbon nanotubes- electronic propertics- synthesis of carbon nanotubes-carbon nanotube interconnects carbon nanotube FETs-Nanotube for memory applications.

UNIT V **9 Hours**

MOLECULAR ELECTRONICS

Electrodes & contacts- functions- molecular electronic devices- first test systems- simulation and circuit design- fabrication; Future applications.

FOR FURTHER READING

MEMS and NEMS -multidisciplinary nature of MEMS/NEMS, Fabrication steps of MEMS/NEMS system, Working principal of MEMS/NEMS capacitive sensor-pressure sensor-thermal sensor-biosensor; MEMS/NEMS applications.

Total: 45 Hours

Reference(s)

1. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.
2. T. Pradeep, NANO: The Essentials- Understanding Nanoscience and Nanotechnology, TMH, 2007
3. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003
4. Saito, S., Carbon Nanotubes for Next-Generation Electronics Device, Science 278 (5335): 77-78. doi:10.1126/science.278.5335.77
5. George W. Hanson, Fundamentals of nano electronics, Prentice Hall, 2008
6. George W. Hanson, Fundamentals of nano electronics, Prentice Hall, 2008

Assessment Pattern

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

Assessment Questions
Remember

1. Who first proposed Nanotechnology ?
2. which transistor will be having the lowest possible size?
3. Discuss about the operating principle and instrumentation setup for STM for a conducting sample and what will be the applicable technique for analyzing a non-conducting sample
4. How you will define nanoelectronics devices?
5. Name different instrumentation parts of a SEM
6. What is Scanning Probe Microscopy?
7. Specify the origin and dimension defined by the term “nano”?
8. “Nanotechnology is not a new concept”: Illustrate with suitable examples?
9. Discuss some properties of fullerene with relevant applications
10. Describe the energy quantization effect in Quantum Dot

Understand

1. Nanostructures have sizes in between .... to .... nm
2. How nano-technology is going to define the future society: elaborate with examples
3. Describe different synthesis and purification techniques for fullerene
4. Discuss some fundamental concepts of Nanoelectronics which separate it from conventional bulk electronics
5. Illustrate the synthesis techniques of CNT and discuss some of its applications
6. Identify the differences between Fullerene and CNT
7. What are the geometrical structures present in C60?
8. What does it mean by 1D nanostructure?
9. “Optical microscopy is not useful at nano scale”: why?

10. Discuss about the operating principle and instrumentation setup for STM for a conducting sample and what will be the applicable technique for analyzing a non-conducting sample?
11. In brief, discuss about the setup, operating principle, data analysis and applications of XRD technique

Apply

1. The probe of scanning tunneling microscope is as sharp as an atom at the tip, why?
2. Discuss about the energy quantization effect in Quantum Well, Quantum Wire and Quantum Dot nanostructures and explore its potential applications?
3. Draw the difference between coarse, fine and nano particles
4. Mention some applications of nano-shell
5. Briefly explore the path of evaluation from bulk to nanotechnology
6. Write in short about 0D, 1D and 2D nanostructures
7. Fullerene is soluble in which organic solvent?
8. Give the identification of MEMS and NEMS
9. What are the steps in top down fabrication approach
10. For the first order diffraction: if, θ=90o and λ=7000?, find the lattice inter planner spacing?
11. Why ‘molecular transistor’ will be the ‘ultimate transistor’?
12. Sol-gel process, electron beam lithography, chemical vapour deposition, ball milling: Classify these fabrication techniques under top-down and bottom up approaches
13. “Smart Dust: Sensor of the Future”: Explain in details about its structure, operation and potential applications

Analyse

1. Which SPM techniques can’t be used for non-conducting sample?
2. Describe the principal of spin FET
3. Nano-scale transistors for future VLSI circuits: elaborate with examples
4. How super conductivity can be achieved with fullerene and what are the potential applications of superconductivity?
5. Discuss about the problems and solutions associated with CMOS scaling
6. Sol-gel process, electron beam lithography, chemical vapour deposition, ball milling: Classify these fabrication techniques under top-down and bottom up approaches

Evaluate

1. Corelate quantum well nanostructure with degrees of freedom
2. Which structure shows negative differential resistance?
3. Differentiate 2D, 1D and 0D nano structures
4. For the first order diffraction: if, θ=90o and λ=7000?, find the lattice inter planner spacing?
5. Write short note on : Scanning Probe Microscopy, Nano-medicine, DNA computer
6. Discuss about different techniques of nano-particles fabrication
7. Why ‘molecular transistor’ will be the ‘ultimate transistor’?

Create

1. Is DNA computation, parallel computation method?
2. Discuss about the energy quantization effect in Quantum Well, Quantum Wire and Quantum Dot nanostructures and explore its potential applications?
3. Consider a MOS capacitor whose gate dielectric stack consists of thicknesses of 0.8 nm and 0.5 nm SiO2 (dielectric constant: 3.9e-11 F/m) and Si3N4 (dielectric constant: 7e-11 F/m), respectively and the substrate doping level is NA=1018cm-3 i) Calculate the overall gate oxide ii) Calculate the threshold voltage for the MOS device (Given: Si dielectric constant: 11.7e-11 F/m, surface potential (inversion):0.84V, body effect: nil).

15EC002 ORGANISATIONAL BEHAVIOUR AND MANAGEMENT

3 0 0 3

Course Objectives

- To enable the students to understand the perspectives of management.
- To give an insight about the functions of management like planning, organizing, staffing, leading and controlling.
- To familiarize the students with organizational culture and help them to manage the changes.

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.
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 ones 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. Select the best alternative by proper Decision making.
2. Influence and moderate the work behavior of different personalities.
3. Solving complex issues by adopting proper conflict management styles.
4. Develop a conducive organizational culture.
5. Analyse the enterprise resource planning

Articulation Matrix

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

UNIT I **9 Hours**

MANAGEMENT OVERVIEW

Management - Definition, nature and purpose, Evolution of management, patterns of management Analysis, Functions of managers, management and society - Operation in a pluralistic society, Social responsibility of managers, Ethics in managing.

UNIT II **9 Hours**

MANAGEMENT FUNCTIONS - I

Planning: Objective(s), Types, Steps, Process, policies. Organizing - Nature and purpose, Decentralization. Staffing - Selection, performance appraisal, career strategy. Departmentation, Line and staff

UNIT III **9 Hours**

MANAGEMENT FUNCTIONS-II

Leading - Behavioral models, Creativity and innovation. Motivation -theories. Leadership - Ingredients of Leadership, Styles. Communication. Controlling -control Techniques. Human Factor in managing

UNIT IV **9 Hours**

ORGANIZATIONAL BEHAVIOUR

Meaning and importance of Organizational Behaviour, challenges and opportunities for Organizational Behaviour, Attitudes Job satisfaction, personality and values. Perception, Groups and Teams Conflict management.

UNIT V **9 Hours**

ORGANIZATIONAL CULTURE AND DYNAMICS:

Organizational Culture- Definition, Functions, creating and sustaining culture, creating an Ethical Organizational culture. Organizational change- forces for change, managing change, change agents, resistance to change, approaches to managing organizational change,Organizational Development in intervention.

FOR FURTHER READING

Global Management-Managerial functions in international business. ERP-SCM-CRM Re- Engineering. TQM- Six Sigma- Information Technology Management.

Total: 45 Hours

Reference(s)

1. Herold Koontz and Heinz Weihrich, Essentials of Management, Mc Graw Hill, New Delhi, 2010.
2. Robbins, Judge, Sanghi, Organizational Behaviour, Pearson, 2009
3. Fred Luthans, Organizational Behaviour, Tata McGraw Hill, 2009

Assessment Pattern

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

Assessment Questions

Remember

1. Define management
2. List the functions of managers.

3. What do you mean by policy?
4. What is staffing?
5. State the functions of attitude.
6. What is group dynamics?
7. Differentiate Strong from Weak cultures.
8. What is the role of change agent?
9. Describe the social responsibility for a manager
10. What is ethics management?

Understand

1. State the functions of attitude.
2. Differentiate Strong from Weak cultures.
3. Explain patterns of management Analysis.
4. Compare and contrast Maslow's and Herzberg's motivation theory
5. Predict the problems involved in creating and sustaining an organizational culture.
6. Discuss the Planning Process.
7. Describe the Evolution of management.
8. Explain the process of formulating career strategy of an employee.
9. Describe the personality attributes influencing Organizational Behaviour.
10. Explain organization development intervention strategies.
11. Explain the imapct of performance apprisal.
12. What is departmentation?

Apply

1. "Formal organization is the intentional structure of roles and informal organization is a network of
   personal and social relations". Comment.
2. Explain the process of formulating career strategy of an employee.
3. Brief about group dynamics?
4. Explain organization development intervention strategies.
5. Organize the different levels in management and how the scope of authority and responsibility varies from one level to the other.
6. Predict the skills required by a manager as he moves up the hierarchy? What methods do you suggest to equip the managers those skills.
7. Assess the importance of conceptual skills for long term survival of an organisation. How do good conceptual skills a firm gain competitive advantage? Give appropriate examples.
8. Examine the different roles played by a manager of a typical business organisation.
9. Predict the roles and responsibilities of major stakeholder of a business organisation.
10. Much of the talk about social responsibility is more of rhetoric in nature. Examine the statement and present your views. You are welcome to interact with management personnel and present your viewpoints.

Analyse

1. If you were the chief executive officer of a large corporation, how would you 'institutionalize' ethics in the organization?
2. Design a performance appraisal matrix for a production Engineer.
3. Many other disciplines have contributed to the discipline of Organizational Behaviour. Justify.
4. Validate why values are important in understanding behaviour of people.
5. High cohesiveness in a group leads to higher group productivity. Comment.
6. Construct a proforma for studying the satisfaction level of employees as influenced by the culture of the organization.
7. Diffrentiate leaders and managers and discuss any one behaviour theory of leadership

Evaluate

1. "Formal organization is the intentional structure of roles and informal organization is a network of personal and social relations". Comment.
2. Illustrate with an example, why change is an ongoing activity in an organization
3. Develop an advertisement for "The Hindu" opportunity column inviting application from potential
   candidates for the post of Director – Information Technology.

Create

1. Create product and product design ideas by searching for consumer needs and screening the various alternatives.
2. Your boss has got the impression that "satisfied workers are productive workers" and has asked you to study this out. In this regard.

15EC003 CONCEPTS OF ENGINEERING DESIGN 3 0 0 3

Course Objectives

- To study the problems in engineering design.
- To know the philosophy and process of engineering design.
- To acquire basic knowledge about Electronic Automation Concepts and intellectual property rights.

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.
PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify the problems in engineering design
2. Explore the method of concept generation and selection
3. Perform the design for new concepts
4. Design and test the concept of Electronic Design Automation
5. Identify the need and purpose of IPR and Patent

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

UNIT I **9 Hours**

ENGINEERING DESIGN AND PROBLEM IDENTIFICATION

Engineering design introduction and definition, Design process, Engineering design interfaces, Principles of Engineering Design. Problem Identification - PDS criteria, Content of a PDS.

UNIT II **9 Hours**

CONCEPT GENERATION AND SELECTION

Introduction -Creativity Principle, Psychological 'set', Inversion, Analogy, Fantasy, Technological advances, Brainstorming, Morphological analysis, Presentation, Exercises. Concept selection- Subjective decision-making, Criteria ranking, Criteria weighting, Datum method, EVAD (Design Evaluation) method, Concept selection method.

UNIT III **9 Hours**

DESIGN PROCESS

Embodiment design - Introduction, Size and strength, Scheme drawing, Form design, Provisional material and process determination, Design for assembly and manufacture, Industrial design, Principles. Modeling - Introduction, Scale models, Simulation, Principles, Exercises.

UNIT IV **9 Hours**

DESIGN CONCEPTS FOR ELECTRONIC AUTOMATION

Need for electronic automation- Concepts of Programmable Logic Controller (PLC)-Basic Functions, Intermediate functions, data handling function-PLC digital bit functions and applications, sequence functions, matrix functions.

UNIT V **9 Hours**

REPORTS AND INTELLECTUAL PROPERTY RIGHTS

Presentation Techniques - Introduction, Concept sketches, Scheme drawing, Design report, Principles. Intellectual Property Rights- Introduction to IP-need for IPR-IPR in India-World Intellectual property Organization (WIPO)- Treaties- consequences and strategies of IPR in developing countries- IPR in business plan- IPR services-IPR in IT and electronic sector- Introduction to Patents- patentable and non patentable inventions-application types-precautions, guidelines, filing of patents- grant of patent.

FOR FURTHER READING

Introduction - The Origin of Laws- Contracts- Liability - Product Liability - Evolution of Product Liability Law - Goals of Product Liability Law - Negligence - Strict Liability - Design Aspect of Product Liability - Protecting Intellectual Property - The Legal and Ethical Domains - Codes of Ethics - Solving Ethical Conflicts

Total: 45 Hours

Reference(s)

1. Ken Hurst, "Engineering Design Principles", Elsevier Science and Technology Books, 1999.
2. Richard Birmingham, Graham Cleland, Robert Driver & DavidMaffin, "Understanding Engineering Design" Prentice Hall of India, 1996.
3. George E. Dieter, Engineering Design, McGraw- Hill International 4th Edition 2009
4. M.S. Peters, K.D. Timmerhaus, R.E. West, Plant Design and Economics for Chemical Engineers, fifth edition. McGraw-Hill, 2003.

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2					6				2				6									3	21
2							5				5				4				3						17
3	2					2				4					4								2		14
4	2					2					6								8					6	24
5		3				3				4					6			8							24
																								Total	100

Assessment Questions

Remember

1. Define engineering design.
2. Write down the steps involved in design process.
3. Define creativity.
4. What are the methods used for creative design?
5. What is brain storming?
6. What are the rules for brain storming?
7. Why ergonomic design is more important?
8. What is simulation?
9. What is ladder diagram?
10. What is IP?
11. What is patent?
12. What are the contents of reports?

Understand

1. How IPR is helpful for business plan?
2. Why IPR is needed?
3. How sequencer function is helpful in PLC?
4. Why PLC is needed?
5. What is stochastic model?
6. What is the importance of modeling?
7. What do you understand from material substitution?
8. Why ergonomics is important in design?
9. What are the factors to be considered while designing a product for environment?
10. How creativity is useful in engineering design?

Apply

1. Develop a design process methodology for the design of rectifier
2. Develop a ergonomic methods in design of computer table with chair.
3. Implement the necessary steps involved in design process.
4. Demonstrate the methods used for concept evaluation with suitable examples.

5. Discuss the components of PLC in detail.
6. Compute any four specifications for washing machine with good efficiency.
7. Demonstrate the entities that come under IP in detail.

Analyse

1. Design and analyze for any electronic product using Subjective decision-making.
2. Develop a need analysis for new electronic product general purpose timer.
3. Develop a engineering design process and create a model for general purpose timer using EDA tool
4. Why bench marking is required? Justify it with an example.
5. Discuss the main considerations for a good design in detail.
6. Analyze the importances of product design.

Evaluate

1. Draw ladder diagram for half adder.
2. Find as many as ides for new product design using brain storming.

Create

1. Develop an engineering design process and fabricate an electronic product regulated power supply.
2. Develop an engineering design process and fabricate an electronic product 4 bit ALU using FPGA.

15EC004 ROBOTIC VISION 3 0 0 3

Course Objectives

- To learn the image fundamentals and mathematical transforms necessary for robotic vision
- To understand the image segmentation and edge detection methods
- To study the concepts of optics and lens systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Apply the basic concepts of robotic vision and image formation techniques.
2. Analyze the geometric and topological properties of binary images

3. Apply the edge detection and segmentation techniques on real time images
4. Diagnose the degree of complications involved in optics related to robotic vision
5. Analyze the applications of robotic vision systems

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to robotic vision- relationship with other related fields- image formation- perspective projection-orthographic projection- brightness- lenses- image sensing- sensing color.

UNIT II **9 Hours**

GEOMETRIC AND TOPOLOGICAL PROPERTIES OF BINARY IMAGES

Simple geometrical properties- area & position- orientation- projection- run length coding- topological properties- multiple objects- labelling components- connectedness- sequential labelling algorithm- local counting & iterative modification.

UNIT III **9 Hours**

IMAGE SEGMENTATION

Regions & objects- image segmentation- thresholding- histogramming- merging and splitting algorithm- edges in images-differential operators- discrete approximations- edge detection & localization

UNIT IV **9 Hours**

OPTICS

Image brightness- radiometry- image formation- BRDF- surface reflectance properties- surface brightness- reflectance map- photometric stereo.

UNIT V **9 Hours**

APPLICATIONS OF ROBOTIC VISION

Picking parts out of a bin- vision based robotic navigation: application to orthopaedic surgery- recognizing human gait types.

FOR FURTHER READING

Robot Vision in Industrial Assembly and Quality Control Processes-Multi-Task Active-Vision in Robotics-An Approach to Perception Enhancement in Robotized Surgery using Computer Vision.

Total: 45 Hours

Reference(s)

1. Berthold Klaus paul horn, Robot vision, The MIT Press, McGraw Hill, 2012.
2. Ales Ude, Robot vision, In-teh,2010
3. Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, Machine Vision, McGraw Hill, 2006.
4. Anil K. Jain, Fundamentals of Digital Image Processing, PHI, 2006.
5. Embedded C programming and the microchip PIC, Barnett Cox & O'Cull.
6. Jane.W.S. Liu, Real-Time systems, Pearson Education Asia, 2009.

Assessment Pattern

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

Assessment Questions

Remember

1. Define level of computation. Mention its types.
2. State Euler number and compactness.
3. Define robotic vision.
4. Write the formula that represents the relationship between pixel coordinates and image coordinates.
5. Define compactness
6. Define object recognition
7. Define image segmentation.
8. State the meaning of sub-graph isomorphism.
9. Recall the figure of merit for an edge detector.
10. Define focal length. How a scene can be zoomed in using focal length?

Understand

1. Summarize canny edge detection algorithm in detail.
2. Illustrate object-centered representation with suitable diagrams.
3. Summarize different components of object recognition system with neat sketch.
4. Exemplify the two methods for range imaging in detail.
5. Explain depth of field in brief.
6. Exemplify the complexities involved in object recognition.
7. Illustrate different distance measures with neat sketch.
8. Explain region growing in detail.
9. Exemplify the different levels of computation.
10. Explain region splitting and merging process used in region segmentation

Apply

1. In a 3x3 image, find the image plane coordinates if the pixel coordinates are [2,3].
2. Predict the Euclidean distance between two components.

0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0

3. Apply thresholding with T=100 for the grey level image shown below

211	50	55	57	159	60	243	240
150	51	52	57	59	60	210	211
254	49	25	155	19	50	211	211
54	49	30	160	20	55	211	211
5	70	180	90	20	85	204	26
10	70	80	90	20	85	20	254

4. Compute the number of connected components to the thresholded image by considering both 4 connectedness and 8 connectedness.

211	50	55	57	159	60	243	240
150	51	52	57	59	60	210	211
254	49	25	155	19	50	211	211
54	49	30	160	20	55	211	211
5	70	180	90	20	85	204	26
10	70	80	90	20	85	20	254

5. Apply size filter with T=2 to the thresholded image by considering 4 connectedness. Also find out the Euler number for the resultant size filtered image by considering 4 connectedness.

21	5	5	5	15	6	24	24
150	51	52	57	59	60	210	211
254	49	25	155	19	50	211	211
54	49	30	160	20	55	211	211
5	70	180	90	20	85	204	26
10	70	80	90	20	85	20	254

6. Implement shrinking followed by expanding operation to the following image.

0	1	0	1
1	0	0	1
0	0	0	0
1	1	1	1
1	0	1	0

7. Apply expanding followed by shrinking operation to the following image

0	1	0	1	0
1	1	1	1	1
1	1	1	0	1
1	1	1	1	0
1	0	0	0	1

8. Implement laplacian edge detector on the following image.

2	2	2	8	8
2	2	2	8	8
2	2	2	8	8
2	2	2	8	8
2	2	2	8	8

9. Apply sobel edge detector on the following image.

2	2	2	2	2
2	2	2	2	2
8	8	8	8	8
8	8	8	8	8
8	8	8	8	8

10. Predict the City block distance between two components

0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0

Analyse

1. Compare the performance of Canny edge detector with other edge detectors.
2. Differentiate first derivative and second derivative operators based on their performance.
3. Justify the need of lens in camera.
4. Conclude the effect in zooming while focal length is increased/decreased.
5. Compare the performance of SCSO and SCMO.
6. Organise the various classifiers used in robotic vision for object recognition.
7. Analyze the limitations of histogram based thresholding.
8. Differentiate diffuse reflection and specular reflection.
9. Justify the effect of changing the DoF in a scene.

Evaluate

1. Evaluate the geometric duality property of dilation and erosion by considering the following image.

0	1	1	1	1
1	1	0	1	0
0	0	0	0	0
1	1	1	1	1
1	0	0	0	1

2. S.E:

*	1

Create

1. Generate a flow chart that explains the various digital image processing techniques used in finger print recognition.
2. Derive the procedure to perform the following operations on the 8 level grey image.
   i) Increasing brightness ii) Reducing brightness iii) Increasing contrast
   iv) Reducing contrast.

15EC005 EMBEDDED PROCESSORS AND NETWORKS

3 0 0 3

Course Objectives

- To introduce the concepts of embedded systems and intertwine it with networks
- To make the students familiar with design and debugging of embedded systems
- To introduce the concept of real time applications of embedded systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze the various methodologies for designing an embedded system
2. Design a real time embedded system using ARM and TIC55xDSP processor

3. Analyze the concept of multiprocessors and Real time operating system
4. Apply the different bus protocols for embedded networking
5. Analyze the various processor technology for embedded system design

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION OF EMBEDDED SYSTEMS

Complex Systems and Microprocessor - Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded Computing system design, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, Formalism for System Design -Structural description, Behavioural description - Preliminaries. Design Example: Model Train Controller

UNIT II **9 Hours**

EMBEDDED PROCESSOR AND COMPUTING SYSTEMS

ARM Processor - Processor and Memory organization, Data operations, Flow of Control, TIC55xDSP - Processor and Memory organization Addressing modes, Data operations, Flow of Control, parallelism with instructions, The CPU Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging. Design Example: Alarm Clock.

UNIT III **9 Hours**

MULTIPROCESSORS AND OPERATING SYSTEMS

Multiprocessors- CPUs and accelerators - Multiprocessors performance analysis - Multiple tasks and multiple processes - Preemptive real time operating systems - Priority based scheduling - Interprocess communication mechanisms - Evaluating operating system performance - Power management and optimization for processes. Design Example: Telephone Answering Machine

UNIT IV **9 Hours**

NETWORKS

Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C bus, CAN bus, SHARC link supports, Ethernet, Myrinet, Fieldbus, Network based design- Internet enabled systems- Vehicles as Networks - Sensor Networks. Design Example: Elevator Controller.

UNIT V **9 Hours**

SYSTEM DESIGN TECHNIQUES

Full custom Technology - Semi custom Technology - PLD Technology -Automation- Verification: Hardware and software co-simulation- Reuse: Intellectual property cores. Design Process Model.

FOR FURTHER READING

Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance.

Total: 45 Hours

Reference(s)

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2011.
2. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, John Wiley & Sons, 2011.
3. Jane.W.S. Liu, Real-Time systems, Pearson Education Asia, 2009.
4. C. M. Krishna and K. G. Shin, Real-Time Systems, McGraw-Hill, 2007
5. Raj Kamal, Embedded Systems: Architecture, Programming and Design, Tata McGraw-Hill, 2012.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				2				6										18
2		2					6				8								8						24
3	2					4				4					4										14
4	2					2					8								8						20
5		2				2				8				4				8							24
																								Total	100

Assessment Questions

Remember

1. What is an embedded system?
2. List out the challenges in embedded system design.
3. List out the characteristics of embedded computing applications.
4. What data types does the SHARC support?
5. How many general-purpose registers are in the SHARC programming model?
6. What does the SHARC CLIP instruction do?
7. Write the specification of embedded system design process.
8. List out the requirements of embedded system design process.
9. Differentiate full custom, semicustom and PLD technology.
10. List out the networks for embedded systems.

Understand

1. Distinguish requirements and specification.
2. List the features of ARM processors.
3. Write the features of TIC55xDSP processors.
4. Draw the hirearchy structure of memory organization.
5. Distinguish Serial Pipeline and parallel pipeline.
6. What is Input and Output devices in embedded processors and mention the primary and secondary memory.
7. Differentiate pre-emptive and non preemptive scheduling.
8. Define RTOS.
9. Distinguish between general purpose and special purpose registers.

Apply

1. How to control the hardware with software?
2. Write down the keyboard scanning algorithm.
3. Explain about multiplexed LED display.
4. Give the applications of Programmable peripheral interface.
5. Explain in detail about recording and playing back system.
6. How to capture analog information in the timer interrupt service routine?
7. Write briefly about Low-level PC serial I/O module.
8. Explain the operation of RS-232 cable.
9. Write down the Embedded C program for stepper motor.
10. Explain about telephonic systems.

Analyse

1. Explain about character LCD module with neat diagram.
2. Discuss the applications about ADC.
3. Give any application about asynchronous serial communication and explain in detail.
4. Discuss in detail about dispatch table multiple point.
5. What is time manager and give any one application.

Evaluate

1. Write in detail about resistor network analysis with example.
2. Explain the hardware software co-simulation.
3. Sketch the system design techniques of full custom technology and explain.
4. Explain semi custom technology in system design techniques.
5. Write the concept vechicle as networks and sensor networks.
6. Explain the CPU bus, memory devices and component interfacing.
7. Differntiate multicore processors and single core processors.

Create

1. How to control a stepper motor using embedded C programming.
2. Design a automatic night lamp with morning alarm uisng embedded processors.

15EC006 CONSUMER ELECTRONICS 3 0 0 3

Course Objectives

- To study the basics of audio and video technology
- To understand the electronic gadgets and telecommunication systems
- To learn the working concepts of consumer appliances

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Illustrate different Microphones and Loudspeakers used in real time applications
2. Analyse different techniques involved in audio processing.
3. Analyse the different television standards
4. Design the different consumer appliances
5. Analyze the evolution and development of Modern Consumer Gadgets and Technology

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

UNIT I **9 Hours**

AUDIO SYSTEM COMPONENTS

Introduction to wave motion -Interference and superposition of waves- Beats, Resonance, Echos-characteristics of microphones- types of microphone- wireless microphones-types of headphones- Types of loudspeakers- Multispeaker systems-Acoustic Insulation and acoustic design. Stereo systems and multiway systems.

UNIT II **9 Hours**

AUDIO PROCESSING

Audio Filters, Types of AGC -Loudspeaker Impedance matching- Pre-emphasis and De-emphasis noise reduction- Optical recording and reproduction- stereophony, Quadraphony-Stereo controls- Active tone control, filtering, bass and treble control-Integrated Stereo amplifier- Equalizers- Codecs -LPC, Sub-band Coding, CELP. MPEG-1, MPEG-2, MPEG-4 and Dolby Digital.

UNIT III **9 Hours**

VIDEO STANDARDS AND SYSTEMS

Elements of a TV system, scanning process- resolution, interlacing, composite signal- Types of TV camera-compatibility between monochrome and colour TV - TV standards- NTSC, PAL, SECAM, CCIR-B.

UNIT IV **9 Hours**

COMMUNICATION AND CONSUMER GADGETS

Radio system- VHF and UHF- Types of mobile phones-Facsimile machine- electronic calculators-digital clocks- Automobile computers- Antilocking Breaking Systems, Electronically Controlled Suspension, Safety Belt System, Navigation System- Microwave Ovens. Dish washers and TV Remote.

UNIT V **9 Hours**

CONSUMER APPLICATIONS

Washing Machines- electronic controller, fuzzy logic, Hardware and Software development- Air Conditioners- Components, Remote Controls, Bar Coders- Bar codes, scanner and decoder- Set Top Box- Types, firmware development, Interactive program guides. Video on demand.

FOR FURTHER READING

TV Broadcasting- video recording formats- Video2000, 8 mm format- video optical recording methods- LaserVision video disc system. Interactive video systems. Principle of video recording on magnetic tapes, block diagram of VCR, VHS tape transport mechanism. Block diagram and principles of working of cable TV and DTH, cable TV using internet.

Total: 45 Hours

Reference(s)

1. S.P.Bali, Consumer Electronics, Pearson Education, 2005. Department of ECE, Bannari Amman Inst. of Tech. | Regulation 2011|Revision 2013 Approved in 9th Academic Council Meeting 183
2. C.A. Schuler and W.L. Mc Namee, Modern Industrial Electronics, McGraw Hill, 2002.
3. D.J. Shanefield, Industrial Electronics for Engineers, Chemists and Technicians, Jaico Publishing House, 2007.

Assessment Pattern

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

Assessment Questions

Remember

1. List the characteristics of microphones?
2. List the functions of air bag systems in automobiles?
3. List the types of Microwave Ovens.
4. List the ideal characteristics of a Camera Tube.
5. List the advantages of microwave cooking.
6. Explain the sequence of operation in a wash cycle.
7. List the practical applications of Waveguides.
8. Draw the frequency response of a Pre-emphasis and De-emphasis filter.
9. Classify the loudspeakers based on the working principle.

Understand

1. How are beats useful in tuning a musical instrument?
2. Explain different sources of noise in tape recording.
3. Explain frame, video bandwidth in Video communication.
4. Explain the working of a Fax machine with Block Diagram.
5. Comment on difference between the contruction of Microphone and Lound Speaker.
6. Write the advantages of multi speaker system over two way speaker system.
7. How will you achieve the best stereo illusion in different rooms?

8. How does an electronic ignition lock system operate?
9. Compare all-air and all-water airconditioning.

Apply

1. Illustrate the limitation of crystal microphone and suggest another microphone which can overcome this limitation.
2. Illustrate the elements of a monochrome television system?
3. Difference between a camera tube and a picture tube.
4. Illustrate the blocks of an air conditioning system.
5. Differentiate longitudinal and transverse waves.
6. Compare ribbon microphone with dynamic microphone.
7. Compare and contrast hue, brightness and saturation.
8. Give practical example on matching a low impedence microphone to high impedence loud speaker.
9. Compare the 525 line American system with CCIR-B system, which system is adopted in our country.
10. Compare and contrast the different cellular systems in operation in India.
11. Explain the significance of waveshaping in Digital Clocks.
12. Explain the operation of ABS in a slippery road with necessary diagrams.
13. How bar codes help in coding the products?

Analyse

1. What is the wave length of a radio station broad casting at 1,000 Hz frequency? Speed of a radio wave is equal to 3*10^8 m/s.
2. In which transformer built in transformer necessary and justify your answer.
3. Differentiate Top Load and front Load Washing Machine.
4. Differentiate Top Load and front Load Washing Machine.
5. Compare and contrast the different cellular systems of operation in India.
6. Compare the 525 line American system with CCIR-B system, which system is adopted in our country.

Evaluate

1. Explain the extended possibilities of soft computing in Washing Machines.
2. Evaluate the extended possibilities of soft computing in Washing Machines.
3. Justify the use of more than 2 speakers in multi-way speaker systems.
4. Justify the use of more than 2 speakers in multi-way speaker systems.
5. Recommend the best microphone that can be used for song recording in studios based on their performance.
6. Judge the reasons for using Gun microphones for recording location sound recording in movie shooting.
7. Select the best Multi-way Speaker System for a living room of a house with reasons to justify the answer.

Create

1. Develop the block diagram level explanation of an air conditioning system which can operate on the basis of Neural Network or Artificial intelligence.
2. Design an Antilock Breaking System (ABS) based on FPGA (Block Diagram only). Comment on its advantages and disadvantages over traditional System.

15EC007 AUTOMOTIVE ELECTRONICS 3 0 0 3

Course Objectives

- To gain the knowledge about starting and charging systems.
- To study the characteristics of Battery and Lighting systems.
- To understand the working of sensors and actuators.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify the current trends in automotive electronics.
2. Demonstrate the concept of starting, charging and Ignition systems.
3. Analyse the working and construction of ignition system
4. Analyse the functionalities of batteries, lighting system, sensors and actuators.
5. Analyse the basic working principles of sensors and actuators used in automobiles.

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Automobile Systems -Engine- Engine control- Ignition system -Ignition timing- Drive train- Suspension-Brakes- Steering system. Control systems- Proportional controller-Proportional Integral controller - Proportional Integral differential controller - Closed-Loop Limit-Cycle Control, electronic dashboard instruments -on-board diagnostic systems

UNIT II **9 Hours**

STARTING AND CHARGING SYSTEMS

Requirements of Starter Motor, Starter Motor types , construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators ,types, construction and Characteristics . Voltage and Current Regulation, Cut-out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three-Phase Alternators.

UNIT III **9 Hours**

IGNITION SYSTEM

Battery Coil and Magneto-Ignition System, Circuit details and Components of Battery Coil and Magneto-Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs, Constructional details and Types. Electronically-Assisted and Full Electronic Ignition System, Non-Contact-type Ignition Triggering devices, Capacitive Discharge Ignition Distributor-less Ignition System, Digital Ignition System.

UNIT IV **9 Hours**

BATTERIES AND LIGHTING SYSTEMS

Principle and construction of Lead Acid Battery, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery-Charging Techniques-Maintenance of batteries. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods.

UNIT V **9 Hours**

SENSORS ACTUATORS

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application- automotive engine control actuators.

FOR FURTHER READING

Security and warning system, Starter switches, Bridge rectifiers and new developments. Horn, wiper system and trafficator, Stepper motors and relay , cooling systems, types of Actuators- Digital micromirror device, Piezoelectric actuator.

Total: 45 Hours

Reference(s)

1. Bechhold, Understanding Automotive Electronics, SAE, 1998.
2. W.H.Crouse, Automobile Electrical Equipment, McGraw-Hill, 1996.
3. A W Judge, Modern Electrical Equipment of Automobiles, Chapman & Hall,
4. P.L.Kholi, Automotive Electrical Equipment, Tata McGraw-Hill, 1995
5. Robert Bosch Automotive Hand Book, SAE, 2000.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	5					10				5															20
2		7				7								6											20
3		5				5				5					5										20
4	10										10														20
5		3	5								7			5											20
																								Total	100

Assessment Questions

Remember

1. List the types of speed sensor.
2. List the different types of oxygen sensor.
3. List the different tests carried on batteries.
4. Define the capacity of lead acid battery.
5. Define Neutral Safety switch
6. List three types of starting drives.
7. list the current trends in Automotive Electronics.
8. List the type of controller.
9. List the engine ignition parts.
10. List the types of Ignition systems.

Understand

1. What is the function of an oxygen sensor?
2. Define air flow meter.
3. Explain the method of obtaining bright and dim beams from the headlights of early automobiles.
4. Explain in detail the characteristics and applications of lead acid battery.
5. Mention the use of drive end frame?
6. Discuss the causes of starting system for noisy operation.
7. What is onboard diagnostic system?
8. Enumerate electronic dashboard instruments with examples.
9. How does the Magnetron Ignition System function? How can it be tested?
10. How is the engine's spark plug serviced?

Apply

1. How the coolant sensor affects engine operation?
2. What is the normal temperature for the coolant in cars?
3. A current passes through two voltmeters in series, one having silver plates and a solution of AgNO3, and other copper plates and a solution of CuSO4. After the current has ceased to flow, 3.6 gm of silver have been deposited. How much copper will have deposited in the other voltmeter? take E.C.E. of silver as 0.001118 gm/C and that of copper as 328.86x10-6 gm/C.
4. What is the minimum cranking speed for a car engine?
5. Discuss the characteristics of various types of d.c motors.
6. Paraphrase in detail about current trends in Automotive Electronic Engine management system
7. What are the advantages and disadvantages of Integral controller.

Analyse

1. Correlate the functional objective for crank shaft position sensor.
2. State the functional objective of an oxygen sensor.
3. Enlighten about chemical changes during charging and discharging of lead acid cell.Enlighten about chemical changes during charging and discharging of lead acid cell.
4. Compare LED lamp and Halogen head lamp.Compare LED lamp and Halogen head lamp.
5. What are the different types of starting motor drives in current practice? describe overrunning clutch drive in detail.
6. Enlist the various limitations of the ignition coil system.
7. Differentiate between voltage and current regulator.
8. Compare proportional and integral controller.
9. Compare current and voltage regulator.

Evaluate

1. Write short note on sealed beam and HID head lamps.
2. Discuss about the three types of pulse generator.
3. Illustrate battery ignition system.

Create

1. Design a system which controls the shaft movement in rice mill for faulty grains.
2. Design an automotive system which ejects defective pencils in its processing unit.

15EC008 MEDICAL ELECTRONICS AND INSTRUMENTATION 3 0 0 3

Course Objectives

- To study the generation of bio-potentials, its representation recording
- To understand electrical and non-electrical parameter measurements
- To study the various diagnostic and therapeutic equipment

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.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify the concepts of Electro-Physiology and Bio-Potential Recording
2. Perform Bio medical and non electrical parameter measurement
3. Demonstrate the concepts of Assist Devices and Bio-Telemetry
4. Realize the concepts of Radiological Equipment
5. Describe the recent trends in Medical Instrumentation

Articulation Matrix

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

UNIT I **9 Hours**

ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING

The Origin of Bio-potentials; bio potential electrodes,biological amplifiers, ECG,EEG,EMG,PCG,EOG,lead systems and recording methods-typical waveform and signal characteristics.

UNIT II **9 Hours**

BIO- CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT

PH,PO2,PCO2,PHCO3,Electrophoresis,colorimeter,photometer, Autoanalyzer,Blood flow meter, cardiac output, respiratory measurement,Blood pressure,temperature,pulse,Blood cell counters

UNIT III **9 Hours**

ASSIST DEVICES AND BIO-TELEMETRY

Cardiac pacemakers,DCDefibrillator, Telemetry principles, frequency selection,Bio-telemetry,radio-pill and tele-stimulation, Signal sources for Analog I/O, Digital I/O waveform generation for testing and calibration

UNIT IV **9 Hours**

RADIOLOGICAL EQUIPMENTS

Ionizing radiation, Diagnostic x-ray equipments, use of Radio Isotope in diagnosis, Multi section Radiography, plane of movement-Radiation Therapy.

UNIT V **9 Hours**

RECENT TRENDS IN MEDICAL INSTRUMENTATION

Thermograph,endoscopy unit,Lasers in medicine, Diathermy units,Electrical safety in medical equipment-Patient monitoring system.

FOR FURTHER READING

DSP based telemetry system for defibrillators and pace makers, Non Invasive Instrumentation, Ultrasonic Measurement, Temperature Measurement, Pneumatic driver for total artificial heart.

Total: 45 Hours

Reference(s)

1. Leislie Cromwell, Bio medical Instrumentation and Measurement,PHI,2007.
2. David Prutchi and Michael Norris, Design and Development of Medical Electronic Instrumentation :A Practical perspective of the design construction and test of Medical Device,2004.

3. RS Khandpur, Hand book of Bio medical Instrumentation, Tata McGraw-Hill,2005.
4. Joseph J. Carr and John M. Brown, Introduction to Bio medical equipment Technology, John Wiley, 2004.
5. David Prutchi and Michael Norris, Design and Development of Medical Electronic Instrumentation :A Practical perspective of the design construction and test of Medical Device, 2004.

Assessment Pattern

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

Assessment Questions

Remember

1. List the uses of Einthoven triangle.
2. Name the leads used in ECG measurements.
3. List the techniques used to reduce noise in EEG machine.
4. List the types of epilepsy.
5. Define resting potential and refractory region cell potential.
6. List the importance of ECG signals.
7. Define colorimeter.
8. Name the instrument used to measure PO2 and PCO2.
9. Define hot spot and cold spot in medical thermograph.
10. List the types of LASERS that are used for patient treatment.

Understand

1. Identify when and where Defibrillators are used?
2. Deduce the Nernst's equation from Goldman's equation for resting potential.
3. Identify advantages of bio telemetry system.
4. Justify the need for ionizing radiation?
5. Identify the different radio isotopes used in diagnosis.
6. Contrast hot spot and cold spot in medical thermograph for cancer diagnosis.
7. Contrast angiography and tomography.
8. Explain the components of the waveform of a typical PCG Signal.
9. Classify Bands of EEG Waveforms based on frequency.
10. Identify the requirements of Biological Amplifier.

Apply

1. Find the open circuit voltage across the patient paddle electrodes of a DC defibrillator using 16 μF capacitor charged to 200 joules.
2. Find the stroke volume in milli litres if the cardiac output is 5.25 litres /min and heart rate is 76 beats/ min.
3. Explain the principles involved in the ON-demand cardiac Pacemaker and cardiovert
4. How would you state the sensitivity characteristics of an electrocardiograph to give a 2-in deflection on a recorder for a 2-mV peak reading

5. Find the hydrogen ion concentration of blood with a pH of 7.4?
6. Calculate the cardiac output for a patient with a heart rate of 72 beats/minute and stroke volume of 75 ml /beat.
7. In the case of ultrasonic blood flow meter, using transit time method, the timer in that flow meter gives the difference between upstream and downstream transit times as 1.7 nanoseconds and the angle between the direction of the flow and the central axis of the ultrasonic beam is about 150. The perpendicular distance between the transmitting and receiving transducers situate in the blood vessel is about 2 cm. The ultrasonic velocity in blood is 1500 m/s. Calculate the velocity of the blood flow in that vessel.
8. In the case of indicator dilution method for the cardiac output measurement, 10 mg of indicator dye is injected. The area under the dilution curve is found to be 150 mgs/litre. Calculate the cardiac output per minute.
9. In the body plethysmograph, the volume of the chamber is 0.20 m3. The max.thorax pressure is Pascals and its minimum is 0.35 Pascals when the patient goes through breathing motions after the mouthpiece valve is closed. Meanwhile the chamber pressure goes from 0.97 Pascals to 1. 03 Pascals. Calculate the total lung capacity.
10. Calculate the velocity of the blood flow in a blood vessel using the following data. The velocity of ultrasonic waves in blood is 1500 m/s. The angle between direction of the blood flow and direction of incident ultrasonic beam is about 300.The Doppler shift in frequency is about 231Hz when the incident ultrasonic frequency is 2 MHz.

Analyse

1. Identify the measurement of Phonocardiography and justify how it is used to identify the Cardiac murmurs.
2. Identify the producer for a flame photometer in the measurement of Potassium ion concentration in body fluids.
3. Define radioisotopes?Explain its use in medical diagnosis.
4. Contrast the difference in the information contained in a phonocardiogram and an electrocardiogram?
5. Justify the reason for increase in blood pressure when a person stands up?
6. Difference between a single-lumen catheter and a multiple-lumen floatation catheter?
7. Justify the reason for skin surface temperature lower then systemic temperature measured orally?
8. For what measurements can a spirometer be used? What basic lung volumes and capacities cannot be measured with a spirometer? Why?

Evaluate

1. With typical waveforms, evaluate the characteristics of EMG and EOG signals and its Recorders.
2. Evaluate the principles involved in various electrical safety of bio medical equipments.

Create

1. PVC's can be identified because a) they arrive early, b) the following beat occurs at the normal time, because it is generated by the SA node, and c) the QRS width is greater than 80 msec. Design an instrument to detect and count PVC's by using all these criteria.
2. Design a circuit that uses one op-amp plus other passive components that will detect QRS complexes of the ECG even when amplitude of the T wave exceeds that of the QRS complex and provides output signals.

15EC009 ADVANCED DIGITAL SIGNAL PROCESSING

3 0 0 3

Course Objectives

- To understand the concepts of random process and advanced transforms.
- To establish the fundamental concepts on signal processing in modern spectral estimation.
- To study the adaptive filters 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.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Apply the statistical properties of discrete random process to analyze the AR, MA and ARMA models
2. Analyze the spectral characteristics of random signals through non-parametric spectral estimation methods
3. Design an optimum digital filters and linear predictors to analyze the real time stationary random signals
4. Design an adaptive filter for the noise cancellation, echo cancellation and channel equalization applications
5. Apply the Short Time Fourier Transform and Wavelet Transform to analyze the non-stationary signals

Articulation Matrix

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

UNIT I **9 Hours**

DISCRETE RANDOM PROCESS

Discrete random process- Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, ARMA, AR and MA processes.

UNIT II **9 Hours**

SPECTRAL ESTIMATION

Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation.

UNIT III **9 Hours**

LINEAR ESTIMATION AND PREDICTION

Forward and Backward linear prediction, Filtering -FIR Wiener filter-Filtering and linear prediction, non-causal and causal IIR Wiener filters.

UNIT IV **9 Hours**

ADAPTIVE FILTERS

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Wein Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters.

UNIT V **9 Hours**

ADVANCED TRANSFORM TECHNIQUES

Short Time Fourier Transform- Continuous Wavelet Transform and Discrete wavelet transforms-properties - types of wavelets-Wavelet Transform Ideal Case - Recursive multi-resolution decomposition -Application to signal compression.

FOR FURTHER READING

Estimation of Parametric model coefficients- Applications of power spectrum estimation - Noise cancellation and speech enhancement using adaptive filter- De-noising using wavelet transforms

Total: 45 Hours

Reference(s)

1. H. Monson Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc., 2008.
2. G. John Proakis and G. Dimitris Manolakis, Digital Signal Processing, Pearson Education, 2006.
3. Sophoncles J. Orfanidis, Optimum Signal Processing, McGraw Hill, 2007.
4. D.G.Manolakis, V.K.Ingle and M.Kogons, Statistical and Adaptive Signal Processing, McGrawHill, 2002.

Assessment Pattern

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

Assessment Questions

Remember

1. Define orthogonality principle.
2. Define AR and MA processes.
3. What is meant by spectrum estimation?
4. What is ensemble average?
5. Draw the first order forward linear predictor.
6. Mathematically define the minimum mean square error of an optimum filter.
7. What is an adaptive filter?
8. Draw the block diagram of noise canceller with and without reference signal.
9. State STFT.
10. Define Wavelets.

Understand

1. When a random process said to wide sense stationary?
2. Write the Akaike Information criteria for ARMA model.
3. When an estimated spectrum is said to be biased and consistent? Compute the same forperidogram estimate.
4. What is the need for spectrum estimation?
5. Find the prediction error of a pth order forward linear predictor.
6. Obtain the minimum mean square error of an optimum filter.
7. List the properties of an adaptive filter.
8. Develop the steepest descent algorithm and hence deduce the LMS algorithm with full particulars.
9. Compare STFT and FFT.
10. Mention the significance of DWT.

Apply

1. Given that, [1 2; 3 4], find the auto correlation matrix.
2. Show the matrix representation of relationship between autocorrelation Rx and cross correlation rdx.
3. Obtain the mean and variance of the averaging modified Periodogram estimate.
4. For a given N=1500 samples of a process x (n) compute the resolution of a averaging modified periodogram estimator.
5. Obtain the AR Parameters using linear prediction.
6. Find the prediction error of a pth order backward predictor.
7. Draw the block diagram of noise canceller with and without reference signal.
8. Determine the excess mean square error and misadjustment factor for a LMS adaptive filter.
9. Prove the properties of STFT.
10. Compare the types of wavelets.

Analyse

1. The auto correlation values ryy(0) = 3, ryy(1) = 1 and ryy (2)=0 for a process consisting of a single sinusoid in additive white noise. Determine the frequency , its power and the variance of the additive noise.
2. When an estimated spectrum is said to be biased and consistent? Compute the same for peridogram estimate.
3. Differentiate filtering from smoothing.
4. Adaptive filters are time varying filters. Justify.
5. Why STFT used for non stationary signal? Justify.

Evaluate

1. Determine the mean and the autocorrelation of the sequence x(n) generated by the MA Process described by the difference equation x(n)=w(n)-aw(n-1)+bw(n-2) where w(n) is a white noise process with variance σ2 .
2. If the sample sequence of a RP has 1000 samples .Determine the frequency resolution of Bartlett and Welch method for a quality factor of Q=10 and record length.
3. Design a linear predictor for the random process x(n).
4. How the weight is updated in normalized LMS filter?
5. Compute DWT of given signal.

Create

1. How Fetus's ECG signal is extracted from mother's abdomen ECG? Which consisting both mother's ECG and Fetus's ECG using an adaptive filter? Explain.
2. Explain how the noise is removed from the observed noisy speech signal using an adaptive filter.

15EC010 MEDICAL IMAGE PROCESSING 3 0 0 3

Course Objectives

- To apply 2D and 3D transforms required for image reconstruction.
- To gain sound knowledge about CT, Fluoroscopy and Image quality.
- To understand the concepts of Neuro Magnetic Imaging and MRI.
- Apply the concept of Neuro Magnetic Science in MRI.
- Analyze the principle and operation modes of Ultrasound Imaging

Programme Outcomes (POs)

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

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

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

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

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

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

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify the nuclear medical imaging techniques for acquisition of images
2. Apply 2D and 3D transforms required for image reconstruction.
3. Analyze the x-ray medical imaging techniques and its imaging quality
4. Apply the concept of Neuro Magnetic Science in MRI
5. Analyze the principle and operation modes of Ultrasound Imaging

Articulation Matrix

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

UNIT I **9 Hours**

ACQUISITION OF IMAGES

Introduction to Imaging Techniques - Single crystal scintillation camera - Principles of scintillation camera - multiple crystal scintillation camera - solid state camera - rectilinear scanner- Emission computed Tomography.

UNIT II **9 Hours**

MATHEMATICAL PRELIMINARIES FOR IMAGE RECONSTRUCTION

Image Reconstruction from Projections in Two dimensions- Mathematical Preliminaries for Two and Three dimensional Image Reconstructions - Radon Transform- Projection Theorem - central slice Theorem- Sinogram- Two Dimensional Projection Reconstruction- Three Dimensional Projection Reconstruction- Iterative Reconstruction Techniques.

UNIT III **9 Hours**

FLUOROSCOPY, CT, IMAGE QUALITY

Digital fluoroscopy- Automatic Brightness control - cinefluorography- Principles of computed Tomographic Imaging - Reconstruction algorithms - Scan motions- X-ray sources. Influences of Images quality: Unsharpness- contrast - Image Noise.

UNIT IV **9 Hours**

MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY

Fundamentals of magnetic resonance- overview -Pulse techniques- spatial encoding of magnetic resonance imaging signal- motion suppression techniques- contrast agents- tissue contrast in MRI- MR angiography, spectrography.

UNIT V **9 Hours**

ULTRASOUND, NEUROMAGNETIC IMAGING

Ultrasound: Presentation modes- Time required to obtain Images- System components, signal processing- dynamic Range- Ultrasound Image Artifacts- Quality control, Origin of Doppler shift- Limitations of Doppler systems. Neuromagnetic Imaging: Background.

FOR FURTHER READING

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Medical image fusion, Image visualization- 2D display methods, 3D display methods, virtual reality based interactive visualization

Total: 45 Hours

Reference(s)

1. William R. Hendee, E. Russell Ritenour, Medical Imaging Physics: A John Wiley & sons, Inc., Publication, Fourth Edition 2002.
2. Z.H. Cho., J-oie, P. Jones and Manbir Singh, Foundations of Medical Imaging: John Wiley and sons Inc.
3. Avinash C. Kak, Malcolm Shaney, "Principles of Computerized Tomographic Imaging", IEEE Press, Newyork-1998.

Assessment Pattern

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

Assessment Questions

Remember

1. Define Radon transform.
2. List the properties of Radon transform.
3. What is the main difference between SPECT and PET?
4. Summarize the advantages of Scintillation Camera.
5. Recognize the video camera used in Digital Fluoroscopy and Cini Fluoroscopy.
6. List the four factors influencing Image Quality.
7. Define the principle behind MRI.
8. What is the role of Hydrogen atoms in MRI technique?
9. What is Doppler Effect?
10. List the three modes available in Ultrasound Imaging technique.

Understand

1. Mention different methods to obtain the function f(x,y) from g(s,θ).
2. Compare filtered back projection and iterative reconstruction methods.
3. Compare SPECT and PET.
4. Infer the crystal used in Solid State Camera.
5. Distinguish radiography from fluoroscopy.
6. Why ABC unit is essential in digital fluoroscopy?
7. What is the need of fMRI?
8. Differentiate the FID and Inversion Recovery.
9. What is the need of M mode in Ultrasound imaging?
10. Infer the use of Doppler Effect in Fetal analysis.

Apply

1. Determine the total gain in luminance of an image intensifier with an input screen 9 inch in diameter, output screen 1 inch in diameter and flux gain of 50.
2. Determine the total gain in luminance of an image intensifier with an input screen 6 inch in diameter, output screen 2 inch in diameter and flux gain of 150.
3. Find the resonant frequency for protons in a 2-tesla magnetic field.
4. Draw the pulse sequence of FID.
5. Find the image matrix by back projecting the projection data.
6. Demonstrate ART algorithm with 2x2 image example matrix.
7. Identify the imaging technique for cardiac studies.
8. Apply the principle of Annhilation to obtain PET imaging.
9. Assess the two limitations of Doppler Effect.
10. Design a technique for image reconstruction using Sound Waves.
11. Conclude the applications of PET.

Analyse

1. Outline the Central Slice Theorem from Radon Transform.
2. Justify the need of Intensifier in Fluoroscopy.
3. Diiferentiate the different Pulse Techniques in MRI.
4. Breakdown the advantages of Ultrasound imaging for Fetal analysis.

Evaluate

1. Criticise the use of BGO crystal in PET scan.
2. Determine the sinogram for 90 degree.
3. Choose the appropriate imaging technique for Continuous CT Scan.
4. Criticise the use of fMRI for Brain studies.
5. Determine the attenuation of medium in decibels for an ultrasound beam which is attenuated by a factor of 20.

Create

1. Generalize the performance of back projection and algebraic reconstruction algorithms with a help of a 3X3 image matrix.
2. A region of tissue consists of 3cm fat,2cm muscle,and 3cm liver. Produce the approximate total energy loss of ultrasound in tissue?

15EC011 MACHINE VISION 3 0 0 3

Course Objectives

- To learn the image fundamentals and mathematical transforms necessary for image processing
- To understand the image enhancement and restoration methods
- To study the concepts of optics and lens systems

Programme Outcomes (POs)

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

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

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Apply the geometric properties, algorithms and distance measures of binary images in machine vision
2. Analyze the concept of region splitting and merging in machine vision images
3. Apply the edge detection operators on images and evaluate its performance
4. Diagnose the degree of complications in optical image processing methods
5. Identify the dynamic vision and new developments in object recognition systems

Articulation Matrix

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

UNIT I **9 Hours**

BASICS OF MACHINE VISION

Introduction- Machine vision -Relationship to other fields -Image definitions levels of computation-Binary image processing - Thresholding -Run length encoding Binary algorithms- Definitions -Component labeling -Size filter -Euler number -Region boundary -Area perimeter- compact Distance measures- Distance transforms- Medial axis -Thinning expanding and shrinking, Morphological operators- Simple problems

UNIT II **9 Hours**

REGIONS

Regions and Edges - Regions segmentation- Automatic thresholding, Limitations of Histogram methods-Region representation- array representation - Hierarchical representation - Split and merge- region merging -Removing weak edges-Region splitting - split and merge - Region growing.

UNIT III **9 Hours**

EDGE DETECTION

Gradient-Steps in edge deduction-Roberts operator -sober operator- prewit operator -Comparison Second derivative operator, Laplacian operator, Second derivative- Simple problems using various edge detectors- Gaussian edge Detection -Canny edge detector -Subpixel location estimation -Edge detector performance- methods of Evaluating performance - Figure of merit.

UNIT IV **9 Hours**

OPTICS, SHADING AND DEPTH

Optics - lens equation -Image resolution -Importance of focal length- Depth of Field- view volume -Exposure- shading - Image Inductance -Illumination -Reflector -Surface orientation -shape from shading-depth -Stereo imaging - Cameras in arbitrary position and orientation - Stereo matching -Edge matching -Region correlation shape from X - Range imaging - structural lighting - Imaging Radar- Active vision.

UNIT V **9 Hours**

OBJECT RECOGNITION

object recognition- system components - complexity of object recognition - object representation - observer -centered - object centered representations - feature detection - recognition strategies - classification - Matching Feature indexing - verification - Temperature matching - morphological approach - symbolic- Analogical methods

FOR FURTHER READING

Change detection -Difference pictures - Size filter- Robust change detection- Accumulative difference pictures- Difference pictures in motion detection- Static segmentation and matching

Total: 45 Hours

Reference(s)

1. Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, Machine Vision, McGraw Hill, 2006.
2. Anil K. Jain, Fundamentals of Digital Image Processing, PHI, 2006.
3. Gregory A Baxes, Digital Image Processing, John Wiley, 1994.
4. W.K. Pratt, Digital Image Processing, John Wiley, 2001
5. E.R.Davies, Computer and Machine Vision: Theory, Algorithms, Practicalities, Academic Press is an imprint of Elsevier, 2012
6. C.Rafeal Gonzalez and E.Richard Woods, Digital Image Processing, Third Edition, Pearson Education, 2008

Assessment Pattern

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

Assessment Questions

Remember

1. Define level of computation. Mention its types?
2. State Euler number and compactness.
3. Define machine vision.
4. Write the formula that represents the relationship between pixel coordinates and image coordinates.

5. Define compactness
6. Define object recognition
7. Define image segmentation.
8. State the meaning of sub-graph isomorphism.
9. Recall the figure of merit for an edge detector.
10. Define focal length. How a scene can be zoomed in using focal length?

Understand

1. Summarize canny edge detection algorithm in detail.
2. Illustrate object-centered representation with suitable diagrams.
3. Summarize different components of object recognition system with neat sketch.
4. Exemplify the two methods for range imaging in detail.
5. Explain depth of field in brief.
6. Exemplify the complexities involved in object recognition.
7. Illustrate different distance measures with neat sketch.
8. Explain region growing in detail.
9. Exemplify the different levels of computution.
10. Explain region splitting and merging process used in region segmentation

Apply

1. In a 3x3 image, find the image plane coordinates if the pixel coordinates are [2,3].
2. Predict the Euclidean distance between two components.

0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0

3. Implement shrinking followed by expanding operation to the following image.

0	1	0	1
1	0	0	1
0	0	0	0
1	1	1	1
1	0	1	0

4. Apply expanding followed by shrinking operation to the following image

0	1	0	1	0
1	1	1	1	1
1	1	1	0	1
1	1	1	1	0
1	0	0	0	1

5. Implement laplacian edge detector on the following image.

2	2	2	8	8
2	2	2	8	8
2	2	2	8	8
2	2	2	8	8
2	2	2	8	8

6. Apply thresholding with T=100 for the grey level image shown below

211	50	55	57	159	60	243	240
150	51	52	57	59	60	210	211
254	49	25	155	19	50	211	211
54	49	30	160	20	55	211	211
5	70	180	90	20	85	204	26
10	70	80	90	20	85	20	254

7. Compute the number of connected components to the thresholded image by considering both 4 connectedness and 8 connectedness.

211	50	55	57	159	60	243	240
150	51	52	57	59	60	210	211
254	49	25	155	19	50	211	211
54	49	30	160	20	55	211	211
5	70	180	90	20	85	204	26
10	70	80	90	20	85	20	254

8. Apply sobel edge detector on the following image.

2	2	2	2	2
2	2	2	2	2
8	8	8	8	8
8	8	8	8	8
8	8	8	8	8

9. Apply size filter with T=2 to the thresholded image by considering 4 connectedness. Also find out the Euler number for the resultant size filtered image by considering 4 connectedness.

21	5	5	5	15	6	24	24
150	51	52	57	59	60	210	211
254	49	25	155	19	50	211	211
54	49	30	160	20	55	211	211
5	70	180	90	20	85	204	26
10	70	80	90	20	85	20	254

10. Predict the City block distance between two components

0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0

Analyse

1. Compare the performance of Canny edge detector with other edge detectors.
2. Differentiate first derivative and second derivative operators based on their performance.
3. Justify the need of lens in camera.
4. Conclude the effect in zooming while focal length is increased/decreased.
5. Compare the performance of SCSO and SCMO.

6. Organise the various classifiers used in machine vision for object recognition.
7. Analyze the limitations of histogram based thresholding.
8. Differentiate diffuse reflection and specular reflection.
9. Justify the effect of changing the DoF in a scene.

Evaluate

1. Evaluate the geometric duality property of dilation and erosion by considering the following image.

0	1	1	1	1
1	1	0	1	0
0	0	0	0	0
1	1	1	1	1
1	0	0	0	1

2. S.E:

*	1

Create

1. Generate a flow chart that explains the various digital image processing techniques used in finger print recognition.
2. Derive the procedure to perform the following operations on the 8 level grey image.i) Increasing brightness ii) Reducing brightness iii) Increasing contrast iv) Reducing contrast

15EC012 ADVANCED 4G WIRELESS MOBILE COMMUNICATIONS 3 0 0 3

Course Objectives

- To learn the concepts of OFDM and channel models
- To understand the peak power problem and the methods of reducing it
- To understand the concept of Channel Estimation Techniques.
- To have a knowledge of the basics of Synchronization For OFDM

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze the concepts and Mathematical modeling of OFDM for wireless communication systems.
2. Discuss the PAPR problems of OFDM for wireless communication systems.
3. Discuss different types of synchronization of OFDM systems.
4. Apply the various Channel Estimation Techniques.
5. Describe the various Channel Estimation and channel coding Techniques

Articulation Matrix

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

UNIT I **9 Hours**

ORTHOGONAL FREQUENCY-DIVISION MULTIPLEXING

Orthogonality, Concept of single-carrier and multi-carrier modulation ,Guard Time and Cyclic Prefix Extension, Time Domain Representation of the OFDM Signal, Discrete Time Domain Representation of the OFDM Signal, OFDM System Block Diagram- Modulation, Serial to Parallel Conversion, BER of OFDM Scheme, Water-Filling Algorithm for Frequency.

UNIT II **9 Hours**

SYNCHRONIZATION FOR OFDM

Effect/Estimation of Symbol-Time Offset (STO), Effect/Estimation of Carrier-Frequency Offset (CFO), and Effect/Compensation of Sampling-Clock Offset (SCO).

UNIT III **9 Hours**

PAPR REDUCTION

Distribution of PAP ratio, Clipping and Peak Windowing, Peak Cancellation, PAP Reduction Codes, Mitigation Methods- Clipping & Filtering, Selective Mapping (SLM), Partial Transmit Sequence (PTS), Tone Reservation (TR), Tone Injection (TI), PAPR in OFDM System.

UNIT IV **9 Hours**

CHANNEL ESTIMATION AND EQUALIZATION

Channel Estimation:Pilot Structure- Block-Type Pilot Arrangement, Comb-Type Pilot Arrangement, Interpolation Techniques, Training Symbol-Based Channel Estimation, DFT-Based Channel Estimation, Decision-Directed Channel Estimation, Advanced Channel Estimation Techniques. Equalization: Time Domain Equalization, Equalization in DMT, Delay Parameter, Frequency Domain Equalization, Echo Cancellation

UNIT V **9 Hours**

CHANNEL CODING

Need for Coding, Block Coding in OFDM, Convolutional Encoding, Concatenated Coding, Trellis Coding and Turbo Coding in OFDM.

FOR FURTHER READING

Introduction to MIMO, MIMO Architecture and System Model, Deterministic MIMO Channel-Channel Capacity when CSI is Known to the Transmitter , Channel Capacity of SIMO,MISO and random MIMO Channel, MIMO-OFDM.

Total: 45 Hours

Reference(s)

1. OFDM for Wireless Communication Systems, Ramjee Prasad, Artech House,Inc, 2004.
2. MIMO-OFDM Wireless Communications with MATLAB, Yong soo cho and jaekwon Kim, John Wiley & Sons, 2010.
3. Multi-Carrier Communication Systems with Examples in MATLAB-Emad S. Hassan-CRC Press, Taylor & Francis Group, LLC,2016
4. Theory and Applications of OFDM and CDMA- Wideband Wireless Communications, Henrik Schulze and Christian Luders, John Wiley & Sons Ltd, 2005
5. Multi-Carrier Digital Communications Theory and Applications of OFDM- Ahmad R. S. Bahai and Burton R. Saltzberg- Kluwer Academic Publishers, New York, Boston, Dordrecht, London, Moscow, 2002.

Assessment Pattern

Unit/RBT	**Remember**				**Understand**				**Apply**				**Analyse**				**Evaluate**				**Create**				**Total**
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2					6				6				2										18
2		2				6					6			2				8							24
3	2					4				4					4										14
4	2					2					8								6		2				20
5		2				2				8				4				6				2			24
																								Total	100

Assessment Questions

Remember

1. Define orthogonal signal and vectors.
2. List different types of diversity.
3. Define concepts of multicarrier modulation.
4. State singular value decomposition.
5. Define Symbol-Time Offset.
6. Define Carrier-Frequency Offset.
7. Define Sampling-Clock Offset.
8. Draw Block Diagram of OFDM Transmitter.
9. Draw Block Diagram of OFDM Receiver.
10. Define Zero Padding

Understand

1. Explain the OFDM System Model and Mathematical modeling.
2. Classify the types of diversity.
3. Explain the concept of multicarrier modulation.
4. How to overcome interference in OFDM system.
5. What is OFDM Guard Band?
6. How to overcome PAPR in OFDM System.
7. Describe the function MIMO-OFDM System.

8. Compare the working principle of SC-OFDM and MIMO-OFDM System.
9. Compare the Cyclic Prefix and Cyclic Suffix.
10. Compare the Guard band and Guard interval.

Apply

1. Sketch the block diagram of OFDM Transmitter and Receiver.
2. Examine the analytical expression for OFDM System.
3. Illustrate the water filling algorithm.
4. Illustrate in detail Advanced Channel Estimation Techniques

Analyze/ Evaluate

1. Classify the linear and non-linear Receivers.
2. Justify how PAPR is reduced in SC-OFDM.
3. Evaluate the performance of BER for OFDM System.
4. Explain mitigation methods.

15EC013 WIRELESS AD-HOC AND SENSOR NETWORKS

3 0 0 3

Course Objectives

- To gain knowledge in wireless network protocol and standards.
- To study the MAC, Routing protocols for ad hoc networks.
- To learn the concept of security mechanism for wireless networks

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Demonstrate the current ad-hoc/sensor technologies by researching key areas such as algorithms,protocols and applications
2. Identify the major issues associated with ad-hoc/sensor networks and supporting software in adhoc/sensor networks.
3. Create a wireless network scenario and analyse its performance using network simulator
4. Choose security component for five layers of networks
5. Analyze the characteristics of different security protocols

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Ad-Hoc wireless networks- Packet radio networks-Key definitions of ad-hoc and sensor networks- Advantages of ad-hoc and sensor networks -Unique constraints and challenges and Vulnerabilities- Wireless Communications/Radio Characteristics. Applications of Ad-Hoc/Sensor Network and Future Directions: Driving Applications- Ultra wide band radio communication- Wireless fidelity systems-optical wireless networks - Simulation of Wi-Fi using QUALNET simulator.

UNIT II **9 Hours**

MEDIA ACCESS CONTROL (MAC) PROTOCOLS

Issues in designing MAC protocols-Bandwidth efficiency-Quality of service support-Synchronization-hidden node-exposed node problems. Classifications of MAC protocols :Contention based protocols-MACAW- Media access protocol for wireless LAN-media access with reduced handshake- contention based with reservation mechanisms-Distributed priority-scheduling. Mac protocols using directional antenna. Simulation of 802.11using QUALNET

UNIT III **9 Hours**

ROUTING PROTOCOLS

Issues in designing routing protocols-Mobility-bandwidth constraint-Table driven routing protocols :DSDV, ,WRP, CHGSRP, - On demand routing protocol : AODV,DSR, TORA,LAR,ANODR- zone routing protocol-Fish eye state routing protocol-power aware routing protocol. Simulation of routing protocols using QUALNET simulator.

UNIT IV **9 Hours**

WIRELESS SENSOR NETWORKS

Introduction-sensor network architecture-Data dissemination-data gathering-self organizing MAC for sensor networks-Location discovery-Energy efficient issues-Transport layer. Synchronization issues.

UNIT V **9 Hours**

SECURITY ISSUES IN AD HOC / SENSOR NETWORK

Introduction -Need for Security- classification of attack-MAC layer attacks-Network layer attacks-Wired Equivalent Privacy(WEP)-Intrusion prevention scheme- Confidentiality : Symmetric Encryption- DES and Triple DES detection systems- Authentication :Digital Signatures, Certificates, User Authentication, Elliptic Curve Cryptosystems. Intrusion detection sytems : behavior based detection knowledge based detection-watch dog-path rater. Reputaion based system :CORE,CONFIDENT

FOR FURTHER READING

Body area networks: sensors and inter domain and intra domain architecture. VANET: architecture, challenges and applications.

Total: 45 Hours

Reference(s)

1. Siva Ram Murthy. C and Manoj. B.S, AdHoc Wireless Networks: Architectures and Protocols,Prentice Hall PTR, 2014
2. Charles Perkins, Ad hoc Networking, Addision Wesley,2008,Pearson
3. Toh C.K, Ad Hoc Mobile wireless Networks : protocol and Systems, Prentice Hall PTR, 2007
4. Feng zhao, Leonidas Guibas, Wireless sensor network, Morgan Kaufmann publishers, 2005
5. Kazem sohraby, Daniel minoli and Taieb Znati, Wireless sensor networks- Technology, Protocols and Applications, Wiley, 2007
6. T.L.Singhal, Wireless Communication, TMH, 2012

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				6				2										18
2		2				6					6			2				8							24
3	2					4				4					4										14
4	2					2					8								6		2				20
5		2				2				8				4				6				2			24
																								Total	100

Assessment Questions

Remember

1. Define active DoS and passive DoS attacks.
2. Define data dissemination in WSN.
3. Define data gathering in WSN.
4. Define Distributed priority scheduling.
5. List the applications of Ad-Hoc/Sensor Network.
6. List the issues in designing routing protocols for adhoc/sensor networks.
7. List the issues in designing MAC protocols for adhoc/sensor networks.
8. List the challenges and Vulnerabilities of wireless adhoc networks.
9. Define Wired Equivalent Privacy(WEP).
10. Define Symmetric Encryption.

Understand

1. The HV1 packets are 240 bits long and they are sent every six slots. The packets are 1 slot packets sent at the rate of 1600 slots/sec. Find the data rate.
2. Compare MACA and MACAW mechanism.
3. Compare proactive and reactive routing protocols.
4. Compare DES and Triple DES detection systems.
5. Why is the international availability of the same ISM bands important?
6. Find the chips for a 4 stations network.. Assume data sent by 4 stations are Bit 0, Bit 0, Silent and Bit1 respectively. How station3 can detect the data sent by station2.
7. Identify the possible roles of mobile stations, base stations, and planning from the network provider.

8. Infer how a SIM card provides security against fraudulent use of GSM phone.
9. Exemplify the Energy efficient issues in WSN.
10. Classify the types of attacks and possible solutions.

Apply

1. Implement a file transfer in adhoc mode of Wireless LAN & Wi-Fi.
2. Demonstrate the possible implementation of FTP over Bluetooth without TCP/IP using QUALNET tool.
3. Channel quality estimation can be done both at the sender and the receiver. Which is more advantageous? Why?
4. Is a table driven routing protocol suitable for high-mobility environment? Justify your answer.
5. Explain how network security requirements vary in the following application scenarios of adhoc wireless networks:
   a) Home networks
   b) Classroom networks
   c) Military networks
6. Why is it not advisable to use natural-language passwords directly for cryptographic algorithnms? Justify.
7. What is the role of plug-ins today and how do they influence the usability of web pages?
8. How does a SIM card provide security against fraudulent use of GSM phone?
9. Find some application scenarios where contention based, reservation based and packet scheduling based MAC protocols can be used.
10. Compare the use of satellite systems for last-mile connectivity to rural areas, with cellular and WLL systems

Analyse

1. Compare IEEE 802.11, HiperLAN2, and Bluetooth with regard to their ad-hoc capabilities.
2. Compare: i)Adhoc & cellular networkÂ Â Â ii) Adhoc & sensor network.
3. Differentiate MACA & MACAW protocols with neat examples.
4. Compare and contrast infrastructure networks with ad-hoc networks. Give example situations where one type of network is preferred to the other.
5. Differentiate DES and triple DES detection security schemes.

Evaluate

1. A MANET consists of 100 mobile nodes. When two links are broken, two new wireless links are established every one second. Assume that each mobile node is connected to exactly 8 adjacent mobile nodes. Compute the total number of wireless links in the network.
2. IEEE 802.11 WLAN operates at 2 Mbps transmission rate. Compute the Â size of of the file transferred in 16 seconds.
3. Suppose a data frame is to be sent from the node 3 to node 8 in extended service set which had three BSS interconnected via DS. Describe the step by step procedure for routing of the data in WLAN structure.
4. Choose the type of security protocol that will alleviate the effects of DOS attack in a network.
5. Determine the normalized propagation delay for IEEE 802.3 ethernet and IEEE 802.11 using QUALNET.

Create

1. Design and configure a Wi-Fi network setup for hostel room environment.
2. Create a scenario of small adhoc network and justify the performace AODV protocol with and without mobility.

15EC014 WIRELESS NETWORKS 3 0 0 3

Course Objectives

- To study the wireless communication principles and fundamentals.
- To understand the concepts of WLAN,Ad Hoc Wireless Networks, WPAN and WWAN.
- To gain the knowledge about wireless Geo location Systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyse the multiple access technologies in Wireless Network
2. Identify the different IEEE standards used in Wireless LANs.
3. Identify the various issues and challenges in designing a routing protocols for adhoc wireless networks
4. Explore various WAN architectures deployed in wireless networks.
5. Analyse the interfacing mechanisms between different Wireless Network

Articulation Matrix

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

UNIT I **9 Hours**

WIRELESS COMMUNICATION PRINCIPLES AND FUNDAMENTALS

Wireless propagation characteristics and modeling- Voice coding-Multiple access for wireless system-DMA,TDMA, CDMA, CSMA-Performance increasing techniques- Adhoc and semi adhoc concept-wireless services:circuit and packet mode.

UNIT II **9 Hours**

WIRELESS LAN

Wireless LAN application-concerns- Topologies -Physical layer- MAC layer- HYPER LAN 1 MAC sublayer, IEEE 802.11 MAC sublayer-IEEE 802.11a/ 802.11 b / 802.11g-wireless ATM architecture

UNIT III **9 Hours**

AD HOC WIRELESS NETWORKS

Cellular And Adhoc Wireless networks-Applications- issues in adhoc wireless networks -medium access scheme, Routing, multicasting, QoS,security, Energy management- Challenges in designing routing protocol for adhoc networks

UNIT IV **9 Hours**

WIRELESS WAN

Mechanism to support a mobile environment, communication in the infrastructure, IS-95CDMA forward channel, IS- 95 CDMA reverse channel, pallert and frame formats in IS-95, IMT-2000 forward channel in W-CDMA and CDMA 2000, reverse channels in W-CDMA and CDMA-2000, GPRS and higher data rates.

UNIT V **9 Hours**

WPAN AND GEO LOCATION SYSTEMS

IEEE 802.15 WPAN, Home RF, Bluetooth, interface between Bluetooth and 802.11, wireless geolocation technologies for wireless geo location

FOR FURTHER READING

Data delivery approach- HYPER LAN 2 : an ATM compatible WLAN-On demand routing protocol- Short messaging service in GPRS mobile application protocols- Geolocation standards for E.911 service.

Total: 45 Hours

Reference(s)

1. C. Siva RamMurthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2. Kaveh Pahlavan, Prashant Krishnamoorthy, Principles of Wireless Networks,-A united approach -Pearson Education, 2002
3. Jochen Schiller, Mobile Communication, Person Education-2003, 2nd Edn

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				2				6										18
2		2					6				8								8						24
3	2					4				4					4										14
4	2					2					8								8						20
5		2				2				8				4				8							24
																								Total	100

Assessment Questions

Remember

1. What are the types of propagation characteristics?

2. Mention any two multiple access techniques used in wireless networks.
3. Define FDMA.
4. What are types of architecture of LAN?
5. What are the advantages of TDD?
6. Define Handoff.
7. Define HIPERLAN.
8. Define Routing.

Understand

1. List out the IEEE standards used in wireless networks.
2. Differentiate between wired and wireless LAN.
3. Mention the types of third generation protocols.
4. Why is power control important in CDMA?
5. What is GPRS-136?how does it differ from GPRS?
6. Define UMTS.
7. Name the four categories of 2G wireless networks.
8. Name three major cellular standards in the United States and give the name of their wireless access technology.
9. What is the difference between registration and call establishment in a cellular network.
10. What are the bandwidths and chip rates used in WCDMA and how they compare with cdmaone?
11. Why is Power control important in CDMA?
12. What is the importance of color codes in CDPD?
13. What is the difference between power control in 802.11 and power control in cellular systems?
14. Why do we have four addressing slots in the 802.11 MAC and only two in the 802.3?
15. What are the responsibilities of the MAC management sub layer in 802.22?
16. Name four major transmission techniques considered for WLAN standards and give the standard activity associated with each of them.
17. What are the MAC services of IEEE 802.11 that are not provided in the traditional LANs such as 802.3?
18. Why does the MAC layer of 802.11 have four address fields, compared with 802.3, which has two?

Apply

1. Determine the data rates that can be provided for the following cases: i. CS-1 where GMSK is used with a code rate of 0.49 ii. CS-3 where GMSK is used with a code rate of 0.73 iii. PCS-3 where 8-PSK is used with a code rate of 0.6 iv. PCS-6 where 8-PSK is used with a code rate of 1.
2. The IEEE 802.11 operates at 2.4 GHz, transmits100mW, and the minimum acceptable received signal strength for its proper operation is 80 dBM. Using the JTC model; determine its approximated coverage in a three-floor office building.

Analyse

1. A mobile node has a home address of 136.142.117.21 and a care-of address of 130.216.16.5.It listens to agent advertisements periodically. a. The agent advertisement indicates that the care-of address is 130.216.45.3. What happens? Why? b. The agent advertisement indicates that the care-of address is 136.142.117.1.What happens? Why?
2. Considering that the encoded voice in Bluetooth is at 64Kbps in each direction: a. Use packet format for HV1 channels to show that these packets are sent every six slots b. Use packet format for HV2 channels to find how often these packets are sent c. Repeat (b) for HV3 packets.
3. An adhoc 2 Mbps WLAN using ALOHA protocol connects two stations with a distance of 100 m from one another each, on the average generating 10 packets per second. If one of the terminals transmits a 100-bit packet, what is the probability of successful transmission of this packet? Assume that the propagation velocity is 300,000 km/sec and the packets are produced according to the Poisson distribution.

Create

1. Use the equation for generation of CCK to generate the complex transmitted codes associated with the data sequence {0, 1, 0, 0, 1, 0, 1, 1} b.Repeat (a) for the sequence {1, 1, 0, 0, 1, 1, 0, 0} Show that the two generated sequence are orthogonal.
2. Use a software tool like mat lab to generate 1000 impulse responses of the JTC indoor residential radio channel (all 3 cases).Determine the RMS multipath delay spread for each sample and plot the cumulative distribution function.

15EC015 MOBILE COMPUTING 3 0 0 3

Course Objectives

- To acquire solid knowledge in protocols for mobile and wireless communications
- To understand the mechanisms for network management to support mobility
- To recognize the modifications done in transport layer of mobile networks

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyse multiple access mechanism of mobile communication networks
2. Choose short range/broadband wireless technologies for real time applications
3. Design IP addressing and tunneling for IP networks
4. Classify types of TCP protocols for mobile environment
5. Determine the detection and cryptographic solution to overcome attacks

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Medium Access Control : Motivation for Specialized MAC- SDMA- FDMA- TDMA- CDMA- Comparison of Access mechanisms- Tele communications : GSM- DECT- TETRA - UMTS- IMT-200- Satellite Systems: Basics- Routing- Localization- Handover- Broadcast Systems: Overview- Cyclic Repetition of Data- Digital Audio Broadcasting.

UNIT II **9 Hours**

WIRELESS NETWORKS

Wireless LAN: Infrared Vs Radio Transmission- Infrastructure Networks- Infrastructureless Networks- IEEE 802.11 -HIPERLAN - Bluetooth- Wireless ATM: Working Group- Services- Reference Model - Functions - Radio Access Layer - Handover- Location Management- Addressing Mobile Quality of Service.

UNIT III **9 Hours**

MOBILE NETWORK LAYER

Mobile IP : Goals - Assumptions and Requirement - Entities - IP packet Delivery- Agent Advertisement and Discovery -Registration - Tunneling and Encapsulation - Optimization - Reverse Tunneling - IPv6 - DHCP.

UNIT IV **9 Hours**

MOBILE TRANSPORT LAYER

Traditional TCP- Indirect TCP- Snooping TCP- Mobile TCP- Fast retransmit/ Fast Recovery- Transmission/ Timeout Freezing - Selective Retransmission.

UNIT V **9 Hours**

WIRELESS APPLICATION PROTOCOL

Architecture - Datagram Protocol- Transport Layer Security- Transaction Protocol- Session Protocol- Application Environment.

FOR FURTHER READING

Digital Video Broadcasting, Access Point Control Protocol, Ad hoc Networks, Transaction Oriented TCP, Wireless Telephony Application.

Total: 45 Hours

Reference(s)

1. J.Schiller, Mobile Communication, Addison Wesley, 2003
2. William Stallings, Wireless Communication and Networks, Pearson Education, 2003.
3. Singhal, WAP-Wireless Application Protocol, Pearson Education, 2003
4. LotherMerk, Martin. S. Nicklaus and Thomas Stober, Principles of Mobile Computing, Second Edition, Springer, 2003.
5. William C.Y.Lee, Mobile Communication Design Fundamentals, John Wiley, 1993.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			4						4			6											18
2		2			6						6			6				4							24
3		2			2					6					6			4							20
4	2				2									8				6							18
5		2			2					6				4				6							20
																								Total	100

Assessment Questions

Remember

1. List the applications of TDM and FDM.
2. Recall the significance of Kiviat graph.
3. State the reasons for change of addressing format from IPv4 to IPv6.
4. Listout the difference between DAB and DVB.
5. State the features of WLAN and Hiperlan
6. Identify the need for tunneling in mobile communication.
7. Listout the advantages and disadvantages of multicasting.
8. Outline the features of Bluetooth reference model.
9. Identify the challenges of adhoc networks.
10. Recall the applications of WTA.
11. Justify how wireless networks minimize the probability of collisions.

Understand

1. Differentiate hidden node problem and exposed node problem.
2. explain near-far effect in TDMA system.
3. Explain why traditional mobile systems use fixed pattern?
4. identify countermeasures for TDMA, FDMA and SDMA
5. Justify how GEO satellite system can be replaced by fiber optics?
6. Contrast the features between WWAN and WLAN.
7. Distinguish between collision in PHY layer and MAC layer.
8. How does registration on layer3 works?
9. Why DV routing is not suitable in multihop networks?
10. Differentiate function of I-TCP and Mobile TCP.

Apply

1. Why digital modulation is not enough for radio transmission? Suggest three schemes to mitigate narrowband interference and Compare their performance.
2. Considering duplex channels, what are the alternatives for implementation in wireless networks.
3. Compare the features of FDMA,TDMA and SDMA
4. Compared to the TCHs offered, standard GSM could provide a much highered data rate(33.8 kbits/s) when looking at the air interface. What lowers the data rates available to a user?
5. Compare the features of MEO,LEO and GEO orbit satellites.
6. Which web pages would be approriate for distribution via DAB and DVB?
7. Explain the discrepancies exist between the possibilities of HTML and realities of wireless handheld devices? suggest the proposed solutions.
8. How the telephony events integrated into WAP?

Analyse

1. Compare the features of WML and HTML with respect to handheld devices and bandwidth.

2. Predict the enhancement of WAE to the classic client/server model of WEB.Analyse the performance of enhancement schemes.
3. Compare the protocol stacks for WAP 2.0 and WAP.

Evaluate

1. Comment over the performance of various TCP protocols suggested for mobile networks.
2. Show the required steps during handover for a solution with PEP. What are the state and function of foreign agents, home agents, correspondent host, mobile host, PEP and COA before, during and after handover?
3. Compare the performance of AODv and DSR routing algorithms in adhoc and fixed wireless networks.
4. Discuss the the general problems of mobile IP regarding security and support of quality of service.
5. Compare the offered QoS in IEE 802.11, Hiperlan2 and Bluetooth.

Create

1. Think of adhoc networks with fast moving nodes. Suggest a routing algorithm adapted to adhoc network? criticize its performance on highways.
2. Explain how tunneling works in IPVv4-IPV6 networks.
3. Justify the reasons for the dvelopment of wireless ATM. Why did WATM not succeed as stand alone technology?
4. If bluetooth is a commercial success, what are remaining reasons for he use of IR transmission for WLANS?

15EC016 GRID COMPUTING 3 0 0 3

Course Objectives

- To study the basics of Grid computing.
- To acquire knowledge of various architectures for Grid Computing.
- To study the behavior of networks and other systems with grid computing 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.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify the need for grid computing.
2. Analyze the behavior of grid computing architectures.
3. Implement grid computing concepts for various applications.

4. Apply different grid computing techniques
5. Analyze the performance of grid and utility computing

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

UNIT I **9 Hours**

CONCEPTS ON GRIDS

Introduction-Potential applications and benefits of grid computing-Parallel and distributed architectures-parallel and distributed technologies- parallel and distributed computing- performance assessment- web computing- computational grids- enabling technologies- Grid Middleware.

UNIT II **9 Hours**

GRID COMPUTING INITIATIVES

Organizations developing grid standards- network requirements- grid computing anatomy- grid problem-grid computing roadmap-autonomic computing- business on demand and infrastructure realization-service oriented architecture and grid

UNIT III **9 Hours**

GRID COMPUTING TECHNOLOGICAL VIEWPOINT

Open Grid Services Architecture (OGSA)- goal- commercial data center- OGSA platform components-platform services and transport mechanisms- OGSA hosting environment- core networking services transport and security- OGSA infrastructure- basic services -Open Grid Services Infrastructure(OGSI)-grid services- OGSI specification- service data concepts

UNIT IV **9 Hours**

BUILDING GRID

Globus toolkit- Globus security architecture- resource management- information services- data management- setting up Grid environment- Globus installation- Globus configuration-Services startup -commands to use the grid-developing grid enabled applications.

UNIT V **9 Hours**

GRID COMPUTING TOOLKITS

Globus GT3 toolkit- architecture-programming model- sample implementation- high level services-OGSI.NET Middleware solutions- framework implementation

FOR FURTHER READING

Merging the Grid services architecture with the web service- Grid Computing for Message Passing Interface (MPI)- Computer Aided Engineering for Antenna arrays using Grid Computing- Wireless network planning with Grid Computing.

Total: 45 Hours

Reference(s)

1. Joshy Joseph, Craig Fellenstein, Grid Computing, Prentice Hall, 2003.
2. Luciano Tarricone, Alessandra Esposito, Grid Computing for Electromagnetics, Artech House, 2004
3. Vladimir Silva, Grid Computing for Developers, Charles River Media, 2006
4. Globus Toolkit 4 Programming Java services, Morgan Kaufmann, 2006
5. Fredric Magoules, Jie Pan, Introduction to Grid Computing, CRC Press, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				5	5				2														16
2		2				6								6											14
3	2						5			10								5							22
4	2					4					10			10											26
5	4					10				8															22
																								Total	100

Assessment Questions

Remember

1. Define grid computing.
2. Define Virtual Organization.
3. Define SOA interaction pattern.
4. Define OGSI.
5. What are the basic principles of autonomic computing?
6. Define Web service architecture.
7. Define Policy Abstraction.
8. What are the features of Grid Service Container?
9. Define NMI.
10. Define NASA Information Power Grid.
11. List any four examples of Grid portals?

Understand

1. Explain Legion and Nimrod-G middleware Architecture.
2. Explain Commercial Data Center that Drive the OGSA.
3. Explain interaction of Client-side Programming pattern with an OGSI grid service.
4. Explain how XML web service messages are packaged and enveloped?
5. Explain the relationship between Web Service and Grid Service.
6. Explain Grid Architecture layer and its relationship.
7. Explain some of the grid application and their usage patterns.
8. Explain the data and functional requirements of grid computing.
9. Explain grid infrastructure.
10. Name the classification of grid computing organization based on their functional role.

Apply

1. Justify the role of any two organizations involved in the field of usage of grid for medical/physics application.
2. Map a computational grid to its analogue in real world.

3. How are real and abstract IT resources modeled and managed in OGSA?
4. Explain the layered architecture of grid with a neat diagram.
5. Explain policy architecture.
6. Explain security architecture.
7. Mention some of the expression evaluators supported by GT3.
8. Explain metering and accounting.
9. Explain common distributed logging.
10. Explain distributed data access and replication.

Analyse
1. How does grid computing differ from cluster computing, P2P computing and desktop computing?
2. How does grid computing differ from cluster, P2PÂ and desktop computing?
3. How XML messages are packaged and enveloped in a web service.
4. Expain the purpose of OGSI? Describe the ports and interfaces defined in OGSI along with its inheritance hierarchy.
5. Differentiate condor from condor _G.
6. Differentiate between WSDL 1.1 and WSDL1.2.
7. Compare and contrast Grid Computing and P2P computing.
8. Find the two type of message encoding used in WSDL 1.1.
9. Predict the functional requirements of online media and entertainment on CGSA.
10. Compare and contrast service with and Web Grid service.

Create
1. Write about remote execution of Condor-G on Globus managed resource using Globus job Manager.
2. Describe about the relation of grid architecture with other distributed technologies.

15EC017 NETWORK SECURITY 3 0 0 3

Course Objectives
- To gain knowledge on the various attacks in a network
- To acquire knowledge on various encryption standards.
- To build the ability to develop security standard based on the requirement.

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify vulnerability of computer networks to security threats.
2. Analyse various cryptography techniques and their implications on network security
3. Analyse the mathematical models required for cryptography.
4. Analyse the symmetric and public key cryptography.
5. Analyse the hash algorithms and key management techniques in network security

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

UNIT I **9 Hours**

INTRODUCTION

Security Threats, Security Attacks, Security Services, Mechanisms- Model for Network Security-Classical Encryption Techniques- Substitutions-Transpositions Techniques-Stream Cipher, Block Cipher-Block Cipher Modes-ECB-CBC-CFB-OFB

UNIT II **9 Hours**

BLOCK CIPHERS AND THE DATA ENCRYPTION STANDARD

Simple DES-Differential cryptanalysis- DES-Modes of operation-Triple DES -RC4 - BLOWFISH

UNIT III **9 Hours**

FINITE FIELD-NUMBER THEORY

Algorithms in Z, Algorithms in Z, Groups, Rings, Fields- Modular arithmetic- Euclid's algorithm-Finite field of the form GF(p)- Polynomial Arithmetic- Finite field of the form GF(2)-Prime Numbers-Fermat's & Euler's Theorem.

UNIT IV **9 Hours**

TYPES AND ALGORITHMS

Symmetric Key – AES - Public Key Cryptography- Traffic Confidentiality – RSA – ELGAMAL Cryptosystem

UNIT V **9 Hours**

HASH ALGORITHM, KEY MANAGEMENT

Hash Function-Message Digest algorithm (MD5)- Secure Hash Algorithm- Diffie-Hellman Key Exchange- Key Management Techniques- Key Distribution- Key Agreement - Elliptic Curve Cryptography - Digital Signatures- Authentication Protocols

FOR FURTHER READING

Stenography- Attacks- Primality test- factoring, Discrete Logarithms- Pseudorandom Bit Generation, System security- Intruders- Malicious software-viruses-Firewalls- Security Standards.

Total: 45 Hours

Reference(s)

1. William Stallings,"Cryptography and Network Security: Principles and Practice",Prentice Hall Professional Technical Reference, Fourth Edition. 2004
2. Alfred J. Menezes, Paul C.Van OorSchot, Scott A.Van Stone, "Handbook Of Applied Cryptography", CRC Press, 1996.
3. Bruce Schneier,"Applied Cryptography: Protocols, Algorithms, and Source Code in C",Second Edition, Wiley, John & Sons, Incorporated, October 1995.
4. Atul Kahate "Cryptography and Network Security". Tata McGraw-Hill
5. Richard E. Smith,"Internet Cryptography", Addison- Wesley, 1997.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	5					6					6														17
2		6			6						5										5				22
3		5					10				6														21
4	5									5											5	5			20
5	5					5				5					5										20
																								Total	100

Assessment Questions

Remember

1. Recall the types of attacks on encrypted messages.
2. Name the two approaches to attacking a cipher.
3. List four general characteristics of schema for the distribution of the public key.
4. Mention any one technique of attacking RSA.
5. Define weak collision property of a hash function.
6. List the properties a digital signature should possess.
7. Define man in the middle attack.
8. State the technical deficiencies in the Kerberos version 4 protocols.
9. Define honey pots.
10. List the design goals of firewalls.

Understand

1. Identify the key principles of security.
2. Compare stream cipher and block cipher with an example.
3. Indicate the purpose of the Sub Bytes.
4. Identify the role of session key in public key schemes.
5. Interpret the role of compression function in hash function.
6. Representthe block size of MD5 and how indicate the number ofÂ Â bits produced as the message digest.
7. Identify the scenario where Kerberos scheme is preferred.
8. Illustrate the applications of IP security.
9. Classify the typesof intruders in networks.
10. Explain any two approaches for intrusion detection.

Apply

1. With a neat illustration demonstrate the network security model and the important parameters associated with it.

2. Makes an assessment on the disadvantages of ECB mode of operation
3. Predict the types of attacks possible on RSA algorithm.
4. Demonstrate the purpose od S-Boxes in DES.
5. Select the properties to be possessed by a digital signature.
6. Demonstrate the fundamental idea of HMAC.
7. Implement Diffie Hellman key Exchange using a suitable an example.
8. Make an assessment on the strength of DES Algorithm.
9. Demonstrate in detail about the Secure Hash Algorithm.
10. With necessary block diagrams implement the MD5 message digest algorithm.

Analyse

1. Compare Substitution and Transposition techniques.
2. Differentiate stream cipher and block cipher with example.
3. Security level provided by DES algorithm has limitations in two areas, Justify.
4. Organize the encryption and decryption technique using RC4 stream cipher.
5. Differentiate MAC and Hash function.
6. Organize the requirements of hash function.
7. What are the possible ways to distribute the public keys.
8. Analyze MD5 Message Digest Algorithm in detail.
9. Diffie-Hellman algorithm also supports Digital Signature application.
10. Resolve the properties of Hash Function.

Evaluate

1. Choose the aspects to be considered of information security.
2. If a bit error occurs in plain text block b1, determine how far does the error propagate in CBC mode of DES?
3. Users A and B use the Diffie Hellman key exchange technique, a common prime q=11 and a primitive root alpha=7. Determine the following (i) If user A has private key XA=3.What is A’s public key YA? (ii) If user B has private key XB=6 What is B’s public key YB? (iii) What is the shared secret key? Also write the algorithm. (iv) How man in middle attack can be performed in Diffie Hellman algorithm.
4. Summarize the RSA algorithm and perform encryption and decryption using RSA Algorithm:
   p =3; q = 11; M = 5 hared secret key? Also write the algorithm.
5. Determine the gcd (24140,16762) using Euclid’s algorithm.

Create

1. Generate encryption and decryption using RSA Algorithm for the following. P=7; q=11; e=17;
2. Find the ‘n’ and ø(n) value in RSA if P = 7 and Q = 17.

15EC018 OPTICAL COMMUNICATION 3 0 0 3

Course Objectives

- To introduce the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
- To study various optical sources and optical detectors and their use in the optical communication system
- To discuss about digital transmission and its associated parameters on system performance.
- To Compare the characteristics of fiber optic receivers.
- To Design a fiber optic link based on budgets and assess the different techniques to improve the capacity of the 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.

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyse optical fiber communication link, structure, propagation and transmission properties of an optical fiber.
2. Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers.
3. Identify materials used for fiber optic sources and various coupling mechanisms.
4. Compare the characteristics of fiber optic receivers.
5. Design a fiber optic link based on budgets and assess the different techniques to improve the capacity of the system

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO OPTICAL FIBERS

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal Concepts- Linearly Polarized Modes -Single Mode Fibers.

UNIT II **9 Hours**

SIGNAL DEGRADATION OPTICAL FIBERS

Attenuation- Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal Dispersion, Pulse Broadening in GI fibers-Mode Coupling.

UNIT III **9 Hours**

FIBER OPTICAL SOURCES AND COUPLING

Direct and indirect Band gap materials-LED structures-Light source materials-Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition-Rate equations-External Quantum efficiency-Resonant frequencies-Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, lensing schemes.

UNIT IV **9 Hours**

FIBER OPTICAL RECEIVERS

PIN and APD diodes-Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise-Comparison of Photo detectors -Fundamental Receiver Operation- preamplifiers, Error Sources-Receiver Configuration

UNIT V **9 Hours**

DIGITAL TRANSMISSION SYSTEM AND MEASUREMENTS

Point-to-Point links System considerations -Link Power budget -Rise - time budget- bandwidth budget calculations -Noise Effects on System Performance- Principles and operation of WDM, Solitons -EDFA - Basic on concepts of SONET/SDH Network. Principles of OTDR- Attenuation and dispersion.

FOR FURTHER READING

Graded Index fiber structure, Design Optimization of SM fibers, RI profile and cut-off wavelength, Fiber-to- Fiber joints. Fiber splicing, Quantum Limit, Field Measurements, Eye diagram, OADM, Optical switching, Fiber fabrication, Probability of Error in optical receivers, Intensity modulation, TDM.

Total: 45 Hours

Reference(s)

1. Gerd Keiser, "Optical Fiber Communication" McGraw-Hill International, Singapore, 4th edition., 2011.
2. J.H. Franz and V.K. Jain -"Optical Communication-Components and Systems"- Narosa Publishing House, 2000
3. J.Senior,"Optical Communication, Principles and Practice", Prentice Hall of India, 1994.
4. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2				4					4			6											18
2		2				6					6			6				4							24
3		2				2				6					6			4							20
4	2					2								8				6							18
5		2				2				6				4				6							20
																								Total	100

Assessment Questions

Remember

1. What is the fundamental parameter of a single mode fiber?
2. Mention the two causes of intra-modal dispersion.
3. Define population inversion.

4. What is meant by long wavelength cutoff?
5. List the key requirements needed in analyzing a link.
6. Give the relationship between rays and modes.
7. Define quantum limit.
8. What are the advantages of WDM?
9. Distinguish fundamental and higher order solitons
10. Bring out the differences between dispersion shiftedÂ and dispersion flattened fibers.

Understand

1. Where Optical fiber Communication is useful?
2. What are the advantages of optical communication systems over other communication systems?
3. Give the various fiber configurations and state where they are suitably used.
4. What are the limitations of optical communication systems?
5. List the different means of reducing dispersion in optical communication systems.
6. How do you estimate the link power and rise time budget?
7. State the advantages of a WDM system.
8. Mention the various optical sources for use in long haul optical link.
9. Compare the performance various amplifiers used in optical communication.
10. What are soliton pulses? Mention their advantages.
11. What are the sources of noise in a optical fiber communication link?

Apply

1. Name the various optical detectors used in optical communications? Bring out a comparison between them.
2. A multimode fibre has core diameter of 50 um. and cladding refractive index of 1.45. If its modal dispersion is 10 ns/km find its NA?
3. A fibre attenuation of 1.5 dB/km at 1300 nm. If 0.5Â mW of power is initially launched into the fibre. What is the power level after 9 km?
4. If the absoption coefficient of silicon is 0.05 micrometer-1 at 860 nm. Find the penetration depth at which p(x)/Pin= 0.368.
5. A silica optical fibre with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.5 and cladding refractive index of 1.47 Determine
   a) The critical angle at the core-cladding interface
   b) the NA for the fibre
   c) The acceptance angle in air for the fibre
6. Asseses the advantages and disadvantages of the optical fibre communication over other terrestrial communication link.
7. Asseses the advantages and disadvantages of the single mode and multimode step index fibre.
8. Calculate the cut-off wavelength of the single mode fiber with core radius of 4 um.and del = 0.003.
9. Predict the reasons for chromatic dispersion.
10. Enumerate the various SONET/SDH layers.
11. A SI fibre with core refractive index of 1.458 , V=75 and NA = 0.3 is to be operated at 820 nm. What should be its core size and cladding refractive index?. Calculate the total number of modes entering into the fibre.

Analyse

1. Differentiate between Single Mode and Multimode fiber.
2. Compare LED,s and Laser sources.
3. Distinguish between Graded Index and step Index Fibers.
4. Criticise surface and edge emitting LEDs.
5. What were the problems associated with PDH networks

Evaluate

1. Discuss the various approaches in increasing the efficiency(repeater less transmission distance) of a given optical link.
2. Compare the various optical amplifiers.
3. Judge the significance of the intrinisic layer in PIN Diodes
4. Distinguish meridional rays from skew rays.
5. Criticise the receiver error sources.

Create

1. Conculde the conditions and constraints in the formulation and solution of routing and wavekength assignment problem in an optimal way.
2. A distribution network uses an optical bus to distribute the signal to 10 users. Each (5) optical tap couples 10% of the power to the user and has 1???dB insertion loss. Assuming that thestation 1 transmits 1mW of power over the optical bus. Calculate the power received bythe stations 8,9, and 10.

15EC019 SATELLITE COMMUNICATION 3 0 0 3

Course Objectives

- To know the basics of satellite communication.
- To understand the concepts of orbital mechanics, multiple access techniques and spacelinks.
- To gain knowledge on spacecraft subsystems, earth stations and satellite platform 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.

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.

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify Orbital effects in Communication System and analyze performance of Attitude control
2. analyze various subsystems of spacecraft
3. Design and analyze the characteristics satellite links
4. Analyze the various medium access techniques
5. Apply different types of broadcasting/military applications and multimedia services

Articulation Matrix

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

UNIT I **9 Hours**

ORBITAL MECHANICS

Kepler's laws of motion, Orbits, Orbit Equations, Orbit Description, Locating the Satellite in the Orbit and with Respect to Earth, Orbital Elements-Look Angle Determination and Visibility - Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System - Performance Attitude control; Satellite launch vehicles. Spectrum allocations for satellite systems.

UNIT II **9 Hours**

SPACECRAFT SUB SYSTEMS AND EARTH STATION

Spacecraft Subsystems, Altitude and Orbit Control, Telemetry and Tracking, Power Systems, Communication Subsystems, Transponders, Antennas, Equipment Reliability, Earth Stations, Example of payloads of operating and planned systems.

UNIT III **9 Hours**

SPACE LINKS

The Space Link, Satellite Link Design - Satellite uplink -down link power Budget, Basic Transmission Theory, System Noise Temp, G/T Ratio, Noise Figure, Downlink Design, Design of Satellite Links for Specified C/N - Microwave Propagation on Satellite-Earth Paths. Interference between satellite circuits, Energy Dispersal, propagation characteristics of fixed and mobile satellite links.

UNIT IV **9 Hours**

MULTIPLE ACCESS TECHNIQUES AND NETWORK ASPECTS

Single access vs. multiple accesses (MA). Classical MA techniques: FDMA, TDMA. Single channel per carrier (SCPC) access - Code division multiple access (CDMA). Demand assignment techniques. Mobile satellite network design, ATM via satellite. TCP/IP via satellite - Call control, handover and call set up procedures. Hybrid satellite-terrestrial networks.

UNIT V **9 Hours**

SERVICES AND APPLICATIONS

Fixed and mobile services - Multimedia satellite services - Advanced applications based on satellite platforms - INTELSAT series - INSAT, VSAT, Remote Sensing - Mobile satellite service: GSM. GPS, INMARSAT, Navigation System, Direct to Home service (DTH), Special services, E-mail, Video conferencing and Internet connectivity.

FOR FURTHER READING

Mobile Satellite Technology-Telecommunication Satellite -satellite radio-Amateur radio-Low-Earth-orbiting satellites (LEO)-Earth Observation.

Total: 45 Hours

Reference(s)

1. Dennis Roddy, "Satellite Communications", Third Edition, Mc Graw Hill International Editions, 2001.
2. Bruce R.Elbert, "The Satellite Communication Applications Hand Book, Artech House Boston, 1997.
3. Wilbur L.Pritchard, Hendri G.Suyderhood, Robert A.Nelson,"Satellite Communication Systems Engineering", II Edition, Prentice Hall, New Jersey, 1993.
4. Tri T.Ha, "Digital satellite communication", 2nd Edition, McGraw Hill, Newyork, 1990.
5. Fredric Magoules, Jie Pan, Introduction to Grid Computing, CRC Press, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				2				6										18
2		2					8				8				6										24
3	2	2				6				4					4										18
4	2					4				8					4										18
5	2	2				4				6				8											22
																								Total	100

Assessment Questions

Remember

1. State Kepler's three laws.
2. Define Limits of visibility.
3. Define EIRP.
4. Define S/N ratio.
5. Define satellite switched TDMA.
6. Define decoding quenching.
7. Give the frequency range of US DBS systems with high power satellites.
8. Give the frequency range of US DBS systems with medium power satellite.
9. Define DTH.
10. Describe MATV systems in detail.

Understand

1. List the advantages of SPEC method over DSI method.
2. List the limitations of FDMA-satellite access.
3. List the types of digital speech interpolation.
4. Explain in detail the operation of the spade system of demand assignment.
5. Explain the need for reference burst and preamble and post-amble in a TDMA System.
6. Explain the need for demultiplexer in Home receiver indoor unit
7. Explain about indoor and outdoor unit of home receiver.
8. List the applications of Radarsat.
9. List out the INSAT series.
10. Describe briefly the video compression process used in MPEG-2.

Apply

1. A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 hours. Given that the eccentricity is 0.002, calculate the semi-major axis. Assume earth radius a= 6378 km.

2. A satellite downlink at 12 GHz operates with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW.
3. The range between a ground station and a satellite is 42000 km. Calculate the free space loss a frequency of 6 GHz.
4. An antenna has a noise temperature of 35 K and it is matched into a receiver which has a noise temperature of 100 K. Calculate the noise power density and the noise power for a BW of 36 MHz.
5. A satellite is in 322-km high circular orbit Determine. i. Orbital angular velocity. ii. Orbital period. iii. Orbital linear velocity.
6. Definerain rate and effective path length. The earth station attitude is 600m,elevation angle is 50, rain height is 3 km find the slant height, effective path length and horizontal projection of slant height.
7. Determine the limits of visibility for an earth station situated at mean sea level, at latitude 48.42 degree. north and longitude 89.26 degree west. Assume a minimum angle of elevation of 5 degree.
8. Explain what is meant by saturation flux density. An uplink operates at 14 GHz and the flux density required to saturate the transponder is -120 db (w/m2). The free space loss is 207 db and the other propagation losses amount to 2 dB. Calculate the earth station EIRP required for saturation, assuming clear sky condition assumes [RFL] is negligible.
9. A satellite link operating at 14 GHz has receiver feederÂ losses of 1.5 db and a free space loss of 207 db. The atmospheric absorption loss is 0.5 db and the antenna pointing loss is 0.5 db. Depolarization losses may be neglected. Calculate the total linkÂ loss for clear sky conditions.
10. Geostationary satellites use L, C, Ku and Ka bands. The path length from an earth station to the GEO satellite is 38,500 km. For this range, calculate the path loss in decibels forÂ 1 GHzÂ frequency.

Analyse

1. Explain elevation angle and azimuth angle calculation with proper derivations.
2. Explain various orbital effects in communication system performance.
3. Explain cross-polarization discrimination and polarization solution.
4. Exemplify the various design issues related with uplink design and give the Expression C/N ratio for the same.
5. Explain earth station design for low system noise temperature.
6. Explain in detail the geocentric-equatorial coordinate system which is based on the earth's equatorial plane.
7. Explain the need for reference burst and preamble and postamble in a TDMA System.
8. Explain the principle behind spectrum spreading and dispreading and how this is used to minimize interference in a CDMA system. Also determine the throughput efficiency of the system.
9. Describe in your own words how signal acquisition and tracking are achieved in a DS/SS system . And also derive the expression for maximal sequence.
10. Describe the function of the common signaling channel.

Create

1. Design a transmitting earth station to provide a clear air C/N of 26 dB in a C-band transponder at a frequency of 6.285 GHz. Use an uplink antenna with a diameter of 9 m and an aperture efficiency of 68%, and find the uplink transmitter power required to achieve the required C/N. The uplink station is located on the 2 dB contour of the satellite footprint.Â Allow 0.5 dB for clear air atmospheric attenuation and other losses.
2. Design a Ku-band receiving earth station to provide an overall clear air C/N of 17 dB in a 27 MHz IF noise bandwidth at a carrier frequency of 11.45 GHz.The antenna noise temperature is 30 K and the LNA noise temperature is 110 K.Â You may assume a high gain LNA and ignore the noise generated in other parts of the receiver.

15EC020 RF SYSTEM DESIGN 3 0 0 3

Course Objectives

- To study the Radio frequency design of Passive and Active devices.
- To study the concepts of RF amplifiers, matching networks and power amplifiers.
- To explore the concept of mixers and PLL.

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Demonstrate the behavior of passive and active devices at RF
2. Design and analyze the performance of filters and matching networks at RF and Engineering Sciences
3. Design and analyze the performance of diode, amplifiers, mixers and PLL
4. Design and analyze the performance of various noise models of MOSFET, Power Amplifiers
5. Analyze the concept of mixers, Phase Locked Loop

Articulation Matrix

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

UNIT I **10 Hours**

PASSIVE RF COMPONENTS AND TRANSMISSION LINE ANALYSIS

Importance of Radiofrequency design - Dimensions and units - Frequency Spectrum - RF behavior of Passive components - Transmission line analysis - General Transmission line equation - Microstrip Transmission line - Terminated lossless Transmission line - Special termination - Sourced and Loaded Transmission line

UNIT II **8 Hours**

DESIGN OF FILTERS AND MATCHING NETWORKS

Basic Resonator and Filter configurations - Special Filter Realizations - Filter Implementation-Microstripline Matching Networks.

UNIT III **9 Hours**

RF ACTIVE COMPONENTS AND MODELING

Components: RF Diode, RF Bipolar Junction Transistor, RF Field Effect Transistor - Modeling: Diode model, transistor model and FET model. Noise Definition and Noise Models - Two Port noise parameters of MOSFET.

UNIT IV **9 Hours**

IC BASED RF LNA AND POWER AMPLIFIERS

Noise Definition and Noise Models - Two Port noise parameters of MOSFET - LNA Topologies - Noise match and Power match Considerations - Linearity and Large Signal Performance of LNAs - Feedback and RF Stability Criteria - Gain and Phase Margins Power amplifiers: Class A,B,C,D,E,F - PA Characteristics - PA Design examples.

UNIT V **9 Hours**

IC BASED RF BUILDING BLOCKS

Mixers: Fundamentals, Non Linear Mixers, Multiplier based Mixers and Sub-Sampling Mixers - Linearized

PLL Model - Noise Properties of PLLs - Phase Detectors - Loop Filters - Charge Pumps - PLL Design Examples - Oscillators - Describing functions - Resonators

FOR FURTHER READING

Impedance matching using discrete components - Noise model of FET - Compensation Techniques - Detailed considerations of Phase noise

Total: 45 Hours

Reference(s)

1. Reinhold Ludwig Pavel Bretchko, "RF Circuit Design", Pearson Education Asia Publication, New Delhi, 2001.
2. Thomas Lee,"The design of radio Frequency CMOS Integrated circuits", Cambridge University press, 2nd Edition,2004
3. Matthew M. Radmanesh "Radio Frequency and Microwave Electronics illustrated", Pearson Education Asia Publication, New Delhi, 2001
4. Ulrich Rhode, "RF/Microwave Circuit design for Wireless Applications", John Wiley, 2000.
5. Peter P. Kenington "High linearity RF Amplifier Design", Artech House, Mumbai, 2002.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	**F**	**C**	**P**	**M**	
1	2	2				6					8				6										24
2		2					6				8								8						24
3	2	2				4				4					4										16
4	2					2					8								6						18
5		2				2				8								6							18
																								Total	100

Assessment Questions

Remember

1. Define characteristic impedance and propagation constant.
2. List four different types of high frequency resistors, inductors and capacitors
3. Draw the equivalent circuit representation of an inductor, resistor and capacitor
4. Define Smith Chart and mention some of its uses.
5. Define Standing Wave Ratio
6. Define Impedance Matching and Matching Network
7. Draw the equivalent circuit representation of high frequency diodes
8. Draw the noise model of Diode
9. Define Noise Figure and Noise Factor.
10. Define Mixers and list its applications in Communication Systems.

Understand

1. Illustrate the operation of chip resistors and inductors at high frequency applications
2. Explain the high frequency behaviour of passive components
3. Illustrate the tools used for converting lumped component to distributed element
4. Explain the concept of impedance matching using discrete components
5. Explain the operation of Tunnel Diode and Schottky diode
6. Explain the large signal modeling of BJT
7. Classify different types of power amplifiers based on its operation
8. Explain in detail about the topologies of Low Noise Amplifiers
9. Represent the linear and non-linear model of PLL
10. Explain the importance of mixer in superheterodyne receiver

Apply

1. Compute the high frequency impedance of 47pF capacitor whose dielectric medium consists of an aluminium oxide possessing a loss tangent of 10-4 (assumed to be frequency independent) and whose leads are 1.25 cm AWG 26 copper wires
2. A coaxial cable that is assumed lossless has a wavelength of 20 cm at 960MHz. Find the relative dielectric constant of the insulation
3. Plot the insertion loss of a low pass chebyshev filter that has 6dB ripple in the passband and at least 50dB attenuation at f=2*cutoff frequency
4. Use the analytical approach and design a two component matching network that matches the load impedance of 100+j20 ohm to a source impedance of 10+j25 ohm at the frequency of 960MHz
5. Show formally that the noise figure of a resistive attenuator is equal to its attenuation.
6. Construct the noise model of Field Effect Transistor
7. Show that the negative feedback extends bandwidth and reduces noises
8. Demonstrate the process of power amplifier linearizing using polar feedaback.
9. Make the comparative study of active and passive double balanced mixers
10. Compare and contrast the different types of high frequency oscillators

Analyse

1. A copper wire of AWG 26 is 2 cm long. For the frequencies of 100 MHz and 2 GHz compare the internal and external inductances.
2. Derive the input impedance of transmission lines with short circuit and open circuit conditions
3. Double Stub matching networks has several advantages compared to single stub matching networks. Justify
4. Compare the ABCD parameters, attenuation profile and phase response and Gain of Low pass and High pass filters
5. Derive the conversion gain of single bipolar transistor mixer.

Evaluate

1. Determine the circuit parameters of a parallel plate transmission line
2. Prove the second and third order kuroda's identity.
3. Design a 3^{rd} order Chebyshev low pass filter with -3 dB ripple
4. Derive a general expression of the noise bandwidth of a second order low pass filter. Verify that a critically damped second order filter has a noise bandwidth that is about 1.22 times the -3dB bandwidth
5. Design the sample and hold subsampling mixer

Create

1. Generalize the usage of multipliers in high frequency applications
2. Consider an RC diffusion line, a transmission line in which there is no inductance. Derive an expression for the input impedance of such a line when it is terminated in an open circuit.
3.

15EC021 RF MEMS 3 0 0 3

Course Objectives

- To study the action mechanisms of MEMS Switches and relays.
- To study the modeling of mechanical filters, MEMS phaseshifters and pros and cons of micro machined Passive elements
- To present basic overview of microstrip antennas and design parameters.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyse and design RF MEMS relays and switches.
2. Apply the principles of MEMS Inductors and Capacitors
3. Model MEMS phase shifters and its applications.
4. Design micro machined RF filters
5. Analyze the operation of micro machined antennas

Articulation Matrix

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

UNIT I **9 Hours**

RFMEMS RELAYS AND SWITCHES

Introduction-Switch parameters Action Mechanisms of RF MEMS Switches - Electro Static, Magnetic & electromagnetic Bi-stable Relays and microactuators - Dynamics of Switching Operation MEMS Switch Modeling, design evaluation

UNIT II **9 Hours**

MEMS INDUCTORS AND CAPACITORS

Micro machining-Micro machining as a Fabrication process,Fabrication techniques-actuator mechanism-pull-in voltage-Micro machined Passive elements pros and cons-MEMS Inductors-Micro machined inductor-Effect of inductor layout-Approaches for Improving quality factor-Modeling and design issues of planar inductor-Polymer based inductor-MEMS capacitors gap tuning and area tuning capacitors

UNIT III **9 Hours**

MICRO-MACHINED RF FILTERS

Introduction-Modeling of Mechanical Filters-Micro-machined filters-Electrostatic comb drive-Micro mechanical filters using comb drives,electrostatic coupled beam structures -SAW filters Basic/s-Design of Inter Digital Transducers-Capabilities,Limitations and applications-Micro machined filters for mmwave frequencies

UNIT IV **9 Hours**

MEMS PHASE SHIFTERS

Introduction-Types of Phase shifters-Limitations-MEMS phase shifters-Switched delay line, Distributed and polymer based-Ferro electric Phase shifters Distributed and bilateral Inter digitated-Micro machined transmission lines: Losses in Transmission Lines-Coplanar lines-Microshield and membrance supported transmission lines- Micro machined directional; coupler & Mixer.Design, Fabrication and evaluation

UNIT V **9 Hours**

MICROMACHINED ANTENNAS

Introduction-Overview of Microstrip antenna-Design parameters-Micro machining to improve antenna performance-Reconfigurable antennas

FOR FURTHER READING

Dielectric tunable capacitors-MEMS capacitive series switches-CMOS control of RF MEMS capacitive switches-Packaging Challenges of RF MEMS-Process technologies of MEMS

Total: 45 Hours

Reference(s)

1. V.K.Varadan, K.J.Vinoyand K.A. Jose, RFMEMS and their applications, John Wiley & Sons Inc,2006
2. G.M.Rebeiz, RFMEMS:THEORY, Design and Technology:,John Wiley & Sons Inc., 2010.
3. Hector J. DeSantos, RFMEMS circuit Design for Wireless Communications: Artech House,2002
4. www.marubeni-sys.com/mems/coventor/RF_MEMS_Application.pdf

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				2				6										18
2		2					8				8				6										24
3	2	2				6				4					4										18
4	2					4				8					4										18
5	2	2				4				6				8											22
																								Total	100

Assessment Questions

Remember

1. List the basic modelling methods that can be used in RF MEMS design.
2. Give examples of RF MEMS components where the pull-in effect is an advantage or a disadvantage? Why?
3. Explain the effect of the contact resistance and the contact capacitance.
4. Why do you need to use transmission lines for connecting components at RF?
5. Which factors will influence the Q-factor of the c-c beam resonator and how can you increase the Q-factor?
6. Draw a sketch of a spring-suspended two-plate capacitor.
7. When does pull-in occur and why?
8. Explain why hysteresis arises.
9. Give examples of RF MEMS components where the pull-in effect is an advantage or a disadvantage? Why?
10. Why do you put on a DC voltage on the resonator beam? What is the effect?

Understand

1. Describe the analytic modelling of a parallel plate capacitor and the pull-in effect: Draw a sketch of a spring-suspended two-plate capacitor. Which forces are involved when you put on a voltage between the plates? When does pull-in occur and why? Explain why hysteresis arises.
2. RF switch used in an RF transmission line: Why do you need to use transmission lines for connecting components at RF?
   a) If you have a lossless transmission line with characteristic impedance Z0 and load Z_load
   b) How can you obtain a maximum signal transmission to the load?
   c) What happens with the signal in case of an open or shorted transmission line.
3. Describe the structure and operation of a c-c beam used as a resonator.

i) Why do you put on a DC voltage on the resonator beam?Â
ii) Which factors will influence the Q-factor of the c-c beam resonator and how can you increase the Q-factor?
iii)How can you increase the resonating frequency?

4. Describe the structure and operation of a free-free beam used as a resonator. What are the advantages of using an f-f- beam compared to a c-c- beam? Which are the critical parameters for implementing an f-f- beam with optimal performance?
5. Describe the structure and operation of a micromechanical filter implemented as an H-structure.
6. Which factors determine the frequency and bandwidth of the H-filter?
7. Describe a combined mixer-filter structure.
8. How can the mixer-filter block be used in a general RF transceiver?
9. Describe how a 2 plate MEMS capacitor can be used as a tunable capacitor.
10. How does a tunable double air-gap MEMS capacitor function?
11. How can MEMS inductors be implemented? Give examples of in- plane (2-dimensional inductor) and 3D implementations.

Apply

1. How can you combine MEMS and integrated circuits on a single chip (monolithic integration)? Describe typical advantages and disadvantages of the main procedures.
2. How does a tunable double air-gap MEMS capacitor function? o How can you get the maximum tuning range out of such a structure? Describe principal features of an implementation.
3. Draw an equivalent circuit diagram of an RF MEMS inductor and discuss the various parasitic contributions.
4. Where can RF MEMS replace current components in a receiver block?
5. How can you increase the resonating frequency of a c-c beam as a resonator?
6. Why do you put on a DC voltage on the resonator beam?
7. Which are the critical parameters for implementing an f-f- beam with optimal performance?
8. Set up the transfer function for spring-mass-damper.
9. How can the stray components (parasitics) be reduced?
10. Design a microstrip antenna and analyse its parameters.
11. Apply the concept of reconfigurable type system and design the antenna model.

Analyse

1. Analyse the possibilities of MEMS filter bank realization?
2. Analyse the structure and operation of an RF MEMS filter bank.
3. Analyse the design parameters of micro machined antennas.
4. Analyse the working moel of Micro machined directional; coupler & Mixer.
5. Analyse the switch modelling of MEMS.
6. Analyse the micromachining technique used in antenna.
7. Explain the polymer based inductor used in RF MEMS.
8. Explain the working of micro actuators.
9. Explain the gap and area tuning capacitors used in RF MEMS.
10. Analyse the losses in transmission lines.

Create

1. Modelling of spring-mass-damper: Draw a sketch of a typical spring-mass-damper system. Set up the transfer function.
2. Suppose a MEMS contact switch is placed serially in a transmission line having a characteristic impedance of Z0 before and after. Compute the reflection (return loss) of the signal when the switch is open (not conducting).

15EC022 BIO MEMS 3 0 0 3

Course Objectives

- To understand various MEMS fabrication techniques.
- To comprehend different types of sensors and actuators and their principles of operation at the micro scale level.
- To study the application of MEMS in different field of medicine

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. To analyse the different types of sensors and actuators at micro scale level.
2. Classify the sensors and actuators based on mechanical and thermal types in the design of MEMs.
3. Apply the electrostatic & piezoelectric sensors and actuators in the design of MEMs.
4. Design of different types of microfluidic systems in submicrometer and nano scales.
5. Analyse the use of CAD tools for MEMS design.

Articulation Matrix

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

UNIT I **9 Hours**

MEMS AND MICROSYSTEMS

Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezo resistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA

9 Hours

UNIT II

MECHANICAL AND THERMAL SENSORS ,ACTUATORS

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators- beam and cantilever -micro plates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III **9 Hours**

ELECTROSTATIC AND PIEZOELECTRIC SENSORS , ACTUATORS

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator- inchworm motor, inertia sensor, flow sensor.

UNIT IV **9 Hours**

MICROFLUIDIC SYSTEMS

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in micro conduits, in sub micro meter and nano scale. Micro scale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, micro fluid dispenser, micro needle, micro pumps-continuous flow system, micro mixers

UNIT V **9 Hours**

BIO MEMS

Drug delivery, micro total analysis systems

Total: 45 Hours

Reference(s)

1. Tai Ran Hsu,"MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
2. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Wanjun Wang, Steven A.Soper "BioMEMS- Technologies and applications", CRC Press,Boca Raton,2007
4. Chang Liu,'Foundations of MEMS', Pearson Education International, New Jersey, USA, 2006

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	4	4					6				4				2										20
2	2	2				6	6				2								6						24
3	2					4	2			6					6										20
4	2	2				8	2				2														16
5		2				8				2				4				4							20
																								Total	100

Assessment Questions

Remember

1. Name the 2 types of etching available for shaping the geometry of the MEMS components.
2. Define creep deformation? State its relation with temperature.

3. Mention the applications of MEMS in drug delivery.
4. Discuss the general steps involved in the photolithography with positive and negative photo resist.
5. Describe the fabrication procedure of a square tube using LIGA.
6. Define photo resists? Mention its types?
7. Define thermocapillary effect
8. Define doping.
9. Define bulk machining.
10. Define actuator.

Understand

1. Describe the construction and working of inch worm motor.
2. Explain the working of comb drive actuator.
3. Explain the working principle of piezoactuator.
4. Discuss in detail the materials used for MEMS fabrication.
5. Explain in detail the working principle of electrostatic actuator
6. Explain working of micromachined piezoresistive pressure sensor.
7. With neat -diagram explain the working of micromachinedÂ piezoelectric flow sensor.
8. Discuss in detail the different types of actuation methods used in microfliudics.
9. Explain in detail the structure & working of micropumps.
10. Explain in the design of drug delivery system using MEMSÂ fabrication technique.
11. Explain DNA hybridization.

Apply

1. Derive the momentum equation for a moving fluid in a stream tube.
2. Find the pressure drop using Bernoulli equation in a minute stream of alcohol flowing through a section of a tapered tube 20cm in length. The inlet velocity is 500um/s. The mass density of alcohol is 786.6 kg/m3. The tube is inclined 30° from the horizontal plane. The inlet diameter is 200 urn and the outlet diameter is 100 urn.
3. Find Reynolds number for a minute stream of alcohol flowing through a tube with diameter of the tube is 75um and average velocity between the entrance and exit of the tube, V=1.5 X 10"3m/s. The mass density of alcohol is 789.6 Kg/m3 and the dynamic viscosity of alcohol is u= 1199.87 X 10"6N-s/m2.
4. Find the active substrate materials for MEMS.
5. Assess the static bending of thin plates.
6. Assess the use of microplates in drug delivery.
7. Find the uses of shape memory alloys
8. Assess the properties of piezoelectric materials.
9. Compute the equation of equation of motion.
10. Design the micro pump for a continuous flow system.

Analyse

1. Why silicion is used as a seed material in MEMS manufacturing?
2. Explain how CAD is used in MEMS design with an application.
3. Differentiate MEMS and microsystems
4. Differentiate dry etching and wet etching in bulk micromachining.
5. How surface micromaching is implemented for fabrication of MEMS device.
6. Outline the Microactuation with shape alloys.
7. Compare In-plane Si microneedle and Out of plane metallic microneedle.
8. Compare the properties of different types of photoresists.
9. Compare the properties of Silicon, Silicondioxide, Silicon Carbide, SiliconNitride, Quartz and Polysilicon.

Evaluate

1. Criticise the use of silicon as a wafer material.

Create

1. Derive the continuity equation for fluid flow in a microchannel.
2. Design a micro reservoir which can be used for drug delivery.

15EC023 RADAR AND NAVIGATION AIDS 3 0 0 3

Course Objectives

- To study the Doppler principle to radars and to detect moving targets, cluster and tracking radars.
- To learn the principles of transmitters, receivers, antennas and propagation as related to radars.
- To understand principles of navigation, in addition to approach and landing aids as related to navigation.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Illustrate the principles of navigation, in addition to approach and landing aids as related to navigation
2. Apply the radar concepts in detecting & tracking of Targets
3. Analyze the navigation systems using the satellite
4. Identify the methods of navigation & analyze the different radio detection & ranges
5. Analyze the characteristics of navigation systems

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO RADAR EQUATION

Introduction-Basic Radar-The simple form of the Radar Equation-Radar Block Diagram-Radar Frequencies-Detection of Signals in Noise-Receiver Noise and the Signal-to Noise Ratio- Probability Density Functions- Probabilities of Detection and False Alarm-Integration of Radar Pulses- Radar Cross Section of Targets-Radar cross Section Fluctuations-Transmitter Power-Pulse Repetition Frequency-Antenna Parameters-System losses-Other Radar Equation Considerations- Applications of Radar

UNIT II **9 Hours**

RADAR TYPES AND TRACKING

Introduction to Doppler effect-CW Radar- FMCW Radar-MTI Radar-Delay-Line Cancellers-Staggered Pulse Repetition Frequencies-Doppler Filter Banks-Digital MTI Processing-Moving Target Detector-Limitations to MTI Performance-MTI from a Moving Platform (AMIT)-Pulse Doppler Radar -Tracking with Radar-Monopulse Tracking-Conical Scan and Sequential Lobing-Limitations to Tracking Accuracy-Low-Angle Tracking-Tracking in Range-Comparison of Trackers

UNIT III **9 Hours**

DETECTION OF SIGNALS IN NOISE

Matched Filter Receiver-Detection Criteria-Detectors-Automatic Detector-Integrators-Constant-False-Alarm Rate Receivers- The Radar Antenna-Reflector Antennas-Electronically Steered Phased Array Antennas-Phase Shifters-Frequency-Scan Arrays Radar Transmitters and Receivers-Introduction-Linear Beam Power Tubes-Solid State RF Power Sources-Magnetron-Crossed Field Amplifiers.-The Radar Receiver-Receiver noise Figure-Duplexers and Receiver Protectors- Radar Displays

UNIT IV **9 Hours**

RADIO DIRECTION AND RANGES

Introduction-Four methods of Navigation -The Loop Antenna-Loop Input Circuits-An Aural Null Direction Finder-The Goniometer-Errors in Direction Finding-Adcock Direction Finders-Direction Finding at Very High Frequencies-Automatic Direction Finders-The Commutated Aerial Direction Finder-Range and Accuracy of Direction Finders-The LF/MF Four course Radio Range-VHF Omni Directional Range(VOR)-VOR Receiving Equipment-Range and Accuracy of VOR-Recent Developments. Hyperbolic Systems of Navigation (Loran and Decca)-Loran-A-Loran-A Equipment-Range and precision of Standard Loran-Loran-C-The Decca Navigation System-Decca Receivers-Range and Accuracy of Decca

UNIT V **9 Hours**

SATELLITE NAVIGATION SYSTEM

Distance Measuring Equipment-Operation of DME-TACAN-TACAN Equipment-Instrument Landing System-Ground Controlled Approach System-Microwave Landing System (MLS) -Components of the Doppler Navigation System-Doppler range Equation-Accuracy of Doppler Navigation Systems-Inertial Navigation-Principles of Operation-Navigation over the Earth-Components of an Inertial Navigation System-Earth Coordinate Mechanization-Strapped-Down Systems-Accuracy of Inertial Navigation Systems-The Transit System-Navstar Global Positioning System (GPS)

FOR FURTHER READING

Radar Clutter-surface clutter, sea clutter, Land clutter and weather clutter. Electronic Scanning: Radar Principle of phased array for electronic scanning, Advantages and capabilities of electronic scanning, block diagram of an electronic scanning system and its operation. Track stabilization and advanced navigation systems.

Total: 45 Hours

Reference(s)

1. Merrill I. Skolnik ," Introduction to Radar Systems", 3rd Edition Tata Mc Graw-Hill 2003
2. N.S.Nagaraja, Elements of Electronic Navigation Systems , 2nd Edition, TMH, 2000
3. Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004
4. J.C Toomay, " Principles of Radar", 2ndEdition PHI, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				2				6										18
2		2					8				8				6										24
3	2	2				6				4					4										18
4	2					4				8					4										18
5	2	2				4				6				8											22
																								Total	100

Assessment Questions
Remember

1. List out the types of Radar.
2. State Doppler Effect.
3. Recall Probability density functions.
4. List out four navigation methods.
5. List out four Radar Antennas.
6. Reproduce minimum detectable signal.
7. Define Sequential lobing.
8. List out the five applications of Radar.
9. Define FAR in the receivers.
10. Recall cross field amplifiers.

Understand

1. Role of Matched filters in the receiver.
2. Role of Delay line cancellers in the receivers.
3. Formulate pulse repetition Frequency.
4. Illustrate MTI Radar Transmitter block.
5. Justify False alarm in the receiver.
6. Role of integrators in RADAR receiver.
7. Justify Doppler filter bank.
8. Role of duplexers in Radar section.
9. . Interpolate Moving Target Detector.
10. Identify the varies types of antennas used in the Radar.

Apply

1. Construct the Hyperbolic systems navigation.
2. . Explain the concept of MTI Radar.
3. Explain the working principle of Goniometer.
4. Demonstrate the Microwave Landing System.
5. Explain the working principle of instrument Landing system.
6. Demonstrate continuous wave Radar?
7. Demonstrate FMCW Radar?

8. Formulate the radar cross section of the target. If the radar transmitter operates at 12GHz and transmits 400KW of peak pulse power. If the antenna has a gain of 36dB and the power received from a target at 80Km is 4x10-10 watts.
9. Calculate the maximum range of the target from the radar, if the radar transmitter operates at 12GHz and transmits 500KW of peak pulse power.Â If the antenna has a gain of 40dB and the power received from a target is 4x10-10 watts, the radar cross section of the target is 2.5x10^6 square meters.
10. Construct a ground controlled approach system?

Analyse

1. Determine the operation of DME.
2. Analyze range and accuracy of Direction finder.
3. Evaluate tracking angle, accuracy and range.
4. Analyze the Radar equation and its contributing parameters.
5. Differentiate FMCW radar and CW radar?

Evaluate

1. Evaluate range and accuracy of Commutated Aerial Direction Finder?
2. Determine the operation of Decca Receivers and evaluate its range and accuracy?
3. Determine the operation of LORAN?
4. Analyse the radar frequency bands according to their applications?
5. Evaluate the accuracy of inertial Navigation systems?

Create

1. Design MTI Radar?
2. Summarize the Applications of Radar in real time?

15EC024 MEASUREMENT AND INSTRUMENTATION 3 0 0 3

Course Objectives

- To learn the use of DC and AC bridges for measuring R, L and C
- To learn the use of different types of analog meters for measuring electrical quantities such as current, voltage, power, energy, power factor and frequency
- To learn the applications of CRO, other electronic measuring devices, graphical programming palettes and tools in virtual instrumentation.

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.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Design different Bridge configurations and their applications
2. Design different Embedded projects using Transducers and Sensors
3. Analyze the working of different Equipment used in Instrumentation
4. Design different Virtual Instruments using LabVIEW Software
5. Apply different analog components interfacing techniques for controlled instrumentation system

Articulation Matrix

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

UNIT I **9 Hours**

MEASUREMENT CONCEPTS

Principles of operation and construction of PMMC - Static and dynamic characteristics - units and standards of measurements - error analysis - moving coil, moving iron meters, multi meters - True RMS meters - Bridge measurements: Maxwell, Kelvin, Hay, Schering, Anderson and Wien bridge- Q meters .

UNIT II **9 Hours**

TRANSDUCERS

Classification of transducers-selecting a transducer -strain gauges-temperature transducer-LVDT Advantages and disadvantages- capacitive transducers-Piezo electric transducers - optoelectronic transducers.

UNIT III **9 Hours**

FUNCTION GENERATORS

Function generators - RF signal generators - Sweep generators - Frequency synthesizer - wave analyzer - Harmonic distortion analyzer - spectrum analyzer-heterodyne wave analyzer- frequency counters-time interval measurement-measurement of voltage, current, phase and frequency using CRO.

UNIT IV **9 Hours**

VIRTUAL INSTRUMENTATION

Introduction- block diagram of a virtual instrument physical quantities and analog interfaces-hardware and soft ware user interface-advantages over conventional instruments- architecture of a virtual instruments and its relation to the operating system- overview of software-lab view- graphical user interface- controls and indicators-labels and texts- data types- format- data flow programming-editing-debugging and running a virtual instrument- graphical programming palettes and tools.

UNIT V **9 Hours**

MODERN MEASUREMENT TECHNIQUES

A/D &D/A converters-Elements of a digital data acquisition system - interfacing of transducers - multiplexing - Use of recorders in digital systems-digital recording system-liquid crystal display-computer controlled instrumentation - IEEE 488 bus - fiber optic measurements for power and system loss.

FOR FURTHER READING

Vector meters and distortion meters- Measurement of Pressure, Temperature, and velocity- Special type of CRO-Front panel objects- functions and libraries- Optical time domains reflect meter.

Total: 45 Hours

Reference(s)

1. Ernest, Doeblin, Dhanesh and N.Manik, Measurement Systems- Application and Design, Tata McGraw-Hill, 2007
2. Albert D.Helfrick and William D.Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI, 2003
3. B.C.Nakara, K.K.Chaudhry, Instrumentation Measurement and Analysis, Tata McGraw-Hill , 2004.
4. Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, PHI, 2003.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, PHI, 2003.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	1	2			2	6				6				2											19
2	1	2				8				6			2	2				4							25
3	1	2			2	7				6			1	2											21
4	1	2				6				2	6														17
5	1	2			1	6				2	6														18
																								Total	100

Assessment Questions

Remember

1. Define a simple measurement technique.
2. Mention four types of measurement errors.
3. State the need for calibration.
4. When static characteristics are important? State few of them?
5. Define accuracy.
6. What is precision?
7. What is secondary transducer?
8. What are the three main categories of liquid crystals?
9. Draw the Block Diagram of a Digital Data Acquisition System
10. What is tolerance?

Understand

1. Explain the functional elements of measurement system with block diagram.
2. What is the purpose of wave analyzer?
3. Describe the construction and working of PMMC instrument.
4. What is X-Y recorders? Explain the working of X-Y recorders with aÂ neat sketch.
5. Draw and explain the block diagram of digital storage oscilloscope.
6. What is meant by dataflow program in LabVIEW?
7. Explain about the IEEE 488 bus with necessary information.
8. What are the Advantages of LVDT?
9. Describe briefly about the role of Hardware and Software in Virtual Instrumentation.
10. Give the abbreviation for NRFD and how it is used in IEEE 488 bus.

Apply

1. A set of reading obtained in an experiment is, 49.7, 50.1, 50 , 49.6, 49.7. Determine arithmetic mean, mean deviation, standard deviation and variance.
2. A moving coil voltmeter ha a uniform scale with 100 divisions, the full scale reading is 200V and 1/10 of scale division can be estimated with a fair degree of certainty. Determine the resolution of instrument in volt.
3. The digital input for a 4-bit DAC is 0110. Calculate the final output voltage.
4. A moving coil instrument has the following data: number of turns=100, width of coil=20mm, depth of coil=30 mm, flux density in air gap 0.1Wb/m2. Calculate the deflection torque when a carrying current of 10mA. Also calculate the deflection if spring constant is 2*10-6 Nm/degrees.
5. A moving coil ballistic galvanometer of 200 ohm resistance gives a throw of 70 divisions when the flux through a search coil to which it is connected is reversed. Find the flux density given that the galvanometer constant is 100μC per division and the search coil has 1200 turns, a mean area of 60cm2 and a resistance of 15 ohm?
6. Consider an example for testing an audio amplifier and radio receiver using computer controlled measurement system with diagram.
7. Consider you have to measure the Pulse Width of an input waveform. Design a circuit using, Counter, Logic Gates and a Signal Generator.
8. Consider you are designing an Amplifier for an audio application and observed that there is some distortion present in the output. What type of Analyzer you will use to measure the total distortion?
9. List the Applications of Spectrum Analyzer.
10. How the Virtual Instrumentation changed the traditional Data acquisition, Analysis and Testing in Measurement and Instrumentation?

Analyse

1. Formulate the relation between Digital and Analog Meter.
2. In what way platinum RTD differs from copper RTD?
3. Describe briefly how the recorders are useful in digital system and the elements present in it with a neat sketch.
4. Differentiate Accuracy and Precision.
5. How the Kelvin Double bridge differ from Kelvin Bridge?

Evaluate

1. How the end to end system loss can be detected in fiber optic measurements and list the drawback in it.
2. How the effects of connecting leads is avoided in Kelvin Double Bridge? Justify your answer with Expressions and Neat Diagrams.
3. How we can use Gas Filled Phototube in Motion Picture Industry?
4. Derive the Expression for Gauge factor in Strain Gauge. What do you infer from the expression for Gauge factor?

5. Derive the Expression for Gauge factor in Strain Gauge. What you infer from the expression for Gauge factor?

Create

1. Construct the bridges to measure the unknown resistance, capacitance and inductance.
2. Create a module to find the sum of first five natural numbers using LABVIEW.

15EC025 SYSTEM-ON CHIP

3 0 0 3

Course Objectives

- To impart a general understanding the structure and operation of systems-on-chip.
- To demonstrate the various building blocks of a system-on-chip such as processor, on-/off-chip memories, and interconnects.
- To understand the hardware and software structures used to implement and model inter-component 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze the various design process involved in development of System-on-Chip (SoC)
2. Compare the design process of soft & hard IP and integrate IP blocks into chip
3. Apply the concepts involved in processors and semiconductor memories for System on Chip (SoC) design
4. Analyze the various sub system interconnects and interfaces function for System on Chip (SoC) design
5. Develop a real time System on Chip (SoC) based applications and verify the system using various methodology

Articulation Matrix

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

UNIT I **10 Hours**

SYSTEM ON CHIP DESIGN PROCESS

Technology Challenges - SoC Technology - Verification Technology Options - Architecture of the present day SoC- Canonical SoC Design - SoC De sign Flow - Waterfall - Spiral SoC Design Flow - Hardware- Software Codesign flow- Top Down & Bottom up Design Methodology - Specification requirement, Types of Specification , System Design process, System level design issues, Design for timing closure, Logic design issues - Low Power - EDA Tools and Vendors

UNIT II **8 Hours**

IP CORE/ MACRO DESIGN PROCESS:

Overview of IP Designs- Overview of Design Process- Planning and Specification - Soft IP Vs Hard IP Macro Design Process- Soft - Design Issues - Design Process - Hard Macro Productization - Integrating Blocks into chip

UNIT III **10 Hours**

PROCESSOR AND MEMORIES

Processor: Processor Selection for SoC - Basic Concept of Processor Architecture - Pipeling - Parallel Processing - VLIW Processor - Superscaler Processor - ARM Microarchitecture Memories :Outline of Memory Design - Memory Technology -Cache Memory Basics - SOC (On-Die) - Memory System -Board Based (Off- Die) Memory System - 3T & 1T DRAM Memory Cell, 6T SRAM Memory Cell, PROM, eDRAM , Flash Memory Cell - DRAM Memory Array - SDRAM - DDR SDRAM - Memory compiler

UNIT IV **8 Hours**

SOC SUBSYSTEM INTERCONNECTS AND INTERFACES

Interconnect Architectures- Bus Basic Architecture - SOC System Level Standard Interconnect Busses- ARM AMBA, AXI- Altera Avalon -IBM Core Connect- Silicore WISHBONE- PC Based Interconnects: Ethernet- PCI - USB -E-SATA, SPI - I2C- JTAG - SoC Interconnect Switches- Interfaces: UART - VGA - HDMI

UNIT V **9 Hours**

SOC VALIDATION, VERIFICATION AND APPLICATION

Core Validation Flow - Test Bench - CoSimulation - Emulation - Prototype - Verification architecture, Verification components, Introduction to VMM, OVM and UVM - Applications : Approach for designing SOC Devices - Bluetooth SOC - AES - 3D Graphics Processor - Trimedia Processor- Image Compression - Video Compression -MP3 Audio Decoding - Software Defined Radio (SDR) with 802.16

FOR FURTHER READING

Multicore Processors- MPSOCs - SOC Varieties: Apple A7& A8 - NVIDIA Tegra3 - Qualcomm Snapdragon - Samsung Exynos 4 - Intel Atom, Quark & Skylake SOC - Texas OMAP- ST Ericsson NOVA Thor- AMD Bulldozer SOC - Implementing Reuse based SOC Design- Atmel Concurrent Engineering SoC Design - ASOCs

Total: 45 Hours

Reference(s)

1. Michael J. Flynn, Wayne Luk, Computer System Design: System- on-Chip, Wiley,2012.
2. Prakash Raslinkar, Peter Paterson & Leena Singh, System-on-a-chip verification: Methodology andTechniques, Kluwer Academic Publishers, 2000.
3. Michael Keating, Pierre Bricaud, Reuse Methodology Manual for System- on- a- Chip Designs, Third Edition Kluwer Academic Publishers, 2002
4. Rochit Rajsuman, System-on-a-chip: Design and Test, Artech House, 2007
5. M.Keating, D.Flynn, R.Aitken, A, GibbonsShi, Low Power Methodology Manual for System-on-Chip Design Series: Integrated Circuits and Systems, Springer, 2007
6. Mitic M, Stojcev M. An overview of on-chip buses. Facta Universitatis, series: Electronics and Energetics, 2006;19(3):405-28

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		2	8				8							4			2								24
2	2	8					8											2							20
3	2	8			2	8																			20
4		2											8					8							18
5						4				6											8				18
																								Total	100

Assessment Questions

Remember

1. Define SOC.
2. Define SIP.
3. List the four physical design issues for timing closure.
4. Recall any four soft core deliverables.
5. List any 4 test used in design validation.
6. Recognise any two disadvantages of emulation.
7. List the six general design specifications in the Development Process for Soft/Firm Cores.
8. Define productization of soft cores.
9. Mention the various memory technologies availble for SOC Design.
10. Recall the various options avalible for on chip bus SOC interconnects.

Understand

1. Illustrate the waterfall and spiral SOC design flow.
2. Expalin the various types of design methodologies for SOC design.
3. Compare the Hard macros and Soft macros design process.
4. Classsify the various memory technologies.
5. Explain any three SOC onchip interconnects.
6. Summarise the various SOC verification methodologies.

7. Illustrate the internal block of Bluetooth SOC.
8. Summarize the six categorizations of test benches.
9. Explain the various components of SoC with neat diagram.
10. Summarise any two issues in the design of on chip communication architecture.

Apply

1. Design the Image Compression SoC architecture.
2. Demonstrate the functions of AXI bus in SOC design.
3. Select the best memory technologies which is well suited for low power SOC applications.
4. Design a SoC Structure of Bluetooth device.
5. Design a 6T SRAM Cell for low power SOC applications.
6. Predict the major challenge in the integration of large memory with Logic.
7. Construct architecture of a Philips trimedia SOC processor.
8. Select the best On chip Bus interconnects for SOC applications.
9. Construct the SOC application using PCI and SPI interfaces.
10. Design a AES cryptoprocessor architecture.

Analyse

1. Contrast OVM and UVM.
2. Compare DRAM , SRAM and Flash Memory.
3. Differentiate Pipelining and Parallel Processing.
4. Compare waterfall model and spiral design flow.
5. Outline the structure of AMBA bus.
6. Contrast the Soft and Hard Macro productization process.
7. Justify the necessity SOC require unconventional design flow.
8. Contrast AMBA, Avalon, Coreconnect and Wishbone on Chip Bus.
9. Compare VLIW and Super Scalar Processor.

Evaluate

1. Choose the best Onchip bus interconnects for SOC design.

Create

1. Combine the various buliding blocks of SOC to create a video compression architecture.
2. Generate a media processor using SoC technology.

15EC026 NETWORK ON CHIP 3 0 0 3

Course Objectives

- To understand the fundamentals of NoC and hoe it differs from Soc
- To impart knowledge about testing and energy issues in NoC
- To understand the router architectures and testing of NoC

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Identify the need for NoC.
2. Analyse the Low power concepts used in NoC
3. Demonstrate the different architectures and topologies in NoC
4. Apply the testing concepts in NoC
5. Apply the power reduction techniques in NOC.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO NOC

Introduction System-on-Chip Integration and Its Challenges-SoC to Network-on-Chip: A Paradigm Shift-Research Issues in NoC Development Existing NoC Examples

UNIT II **9 Hours**

INTERCONNECTION NETWORKS IN NETWORK-ON-CHIP

Introduction-Network Topologies-Switching Techniques-Routing Strategies-Flow Control Protocol-Quality-of-Service Support-NI Module

UNIT III **9 Hours**

ARCHITECTURE DESIGN OF NETWORK-ON-CHIP

Introduction-Switching Techniques and Packet Format-Asynchronous FIFO Design-GALS Style of Communication-Wormhole Router Architecture Design-VC Router Architecture Design-Adaptive Router Architecture Design

UNIT IV **9 Hours**

TESTING OF NETWORK-ON-CHIP ARCHITECTURE

NoC testing introduction-Testing communication Fabric-Test Transport time minimization-Testing cores-Heuristic algorithm-PSO based strategy

UNIT V **9 Hours**

LOW-POWER TECHNIQUES FOR NETWORK-ON-CHIP

Introduction-Standard Low-Power Methods for NoC Routers-Standard Low-Power Methods for NoC Links-Local reconfiguration technique.

FOR FURTHER READING

Introduction-3-D Integration: Pros and Cons-Design and Evaluation of 3-D NoC Architecture-System-Level Power Reduction-Applications of 3D NoC

Total: 45 Hours

Reference(s)

1. Santanu Kundu, Santanu Chattopadhyay, Network-on-Chip: The Next Generation of System-on-Chip Integration,,Taylor & Francis group2015.
2. Chrysostomos Nicopoulos, Vijaykrishnan Narayanan, Chita R.Das, Networks-on- Chip Architectures AHolistic Design Exploration, Springer,2009.
3. Fayezgebali, Haythamelmiligi, Hqhahed Watheq E1-Kharashi, Networks-on-Chips theory and practice, CRC press, 2009.
4. Axel Jantsch , Hannu Tenhunen, Networks on Chip, Publisher: Springer; Soft cover reprint of hardcover 1st ed. 2003 edition (November 5, 2010).
5. Giovanni De Micheli , Luca Benini, Networks on Chips: Technology and Tools (Systems on Silicon), Publisher: Morgan Kaufmann; 1 edition (August 3, 2006).
6. M.Abramovici, M.A.Breuer and A.D.Friedman, Digital Systems and Testable Design, Jaico Publishing House, 2004

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1					2	8			8												8				26
2						2				8											8				18
3					2	8								8											18
4	2					3	8						3												16
5		8								6				2			6								22
																								Total	100

Assessment Questions

Remember

1. What are the typical components in a SoC?
2. What are the typical components in a NoC?
3. What do you mean by an IP?
4. Use of sift registers in NoC?
5. Explain in detail aout delay in NoC.
6. Define scalability.
7. Explain in detail about switcing techniques in NoC.
8. Write short notes on mesh topology with a neat diagram.
9. Write short notes on torus topology with a neat diagram.
10. Write short notes on binary tree topology with a neat diagram.
11. Write short notes on store and forward technique.
12. Write in detail about time minimization in NoC testing.

Understand

1. Define NoC.
2. Define NoC.
3. List te advantage of NoC over Bus interconnection.
4. Write about NoC topologies.

5. Explain in detail about application specific irregular topologies with neat diagram.
6. Elaborate about the flow control protocol.
7. Define packet latency.
8. Define flit latency.
9. Define packet spread.
10. Write in detail on fixed short path routing with neat diagram.
11. Explain Heuristic algorithm.

Apply

1. Difference between SoC and NoC.
2. Differntiate SoC to Network-on-Chip: A Paradigm Shift
3. Analyze and write in detail about the various design issues of NoC.
4. What do you mean by an warmole in packet switching.
5. What do you mean by an virtual cut throug in packet switching.
6. With neat diagram explain long wire delay.

Analyse

1. Explain in depth about the various design issues of SoC.
2. Need for NoC over SoC.
3. List any four Design issues in NoC.
4. What is the primary use of an OCB?
5. Explain in detail about packet switching routing protocols.

Evaluate

1. What are the key issues in integrating the core into final SoC?
2. Differentiate between ASIC and FPGA.
3. Define vitrtual channel in NoC wit example.
4. What are the Global interconnect design problems in NoC.

Create

1. Create a network to explain deadlock free routing.

15EC027 APPLIED SOFT COMPUTING 3 0 0 3

Course Objectives

- To inculcate sound knowledge in the applications of soft computing
- To apply different types of optimization techniques for real world problems
- To analyze the concepts of Fuzzy, Neural networks and genetic algorithms

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. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analysis of fuzzy rules, systems and control methods in real world problem.
2. Apply the neural network concepts of supervised and unsupervised learning for pattern recognition.
3. Apply the neuro fuzzy modeling systems and controls for classification.
4. Analyze the concepts of Genetic algorithms and its improvements.
5. Apply soft computing techniques for multi criteria decision making.

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

UNIT I **9 Hours**

FUZZY SYSTEMS

Fuzzy set theory-fuzzy rules and fuzzy reasoning-fuzzy inference systems-decomposition-fuzzy automata and languages-fuzzy control methods.

UNIT II **9 Hours**

NEURAL NETWORKS

Basic concepts-knowledge based processing-single layer perceptron-multilayer perceptron-supervised and unsupervised learning-feed forward and back propagation and counter propagation networks-kohens self organizing networks-Hopfield networks.

UNIT III **9 Hours**

NEURO FUZZY MODELING

Adaptive neuro fuzzy inference systems-classification and regression trees- data clustering-rule base structure identification-neuro fuzzy controls.

UNIT IV **9 Hours**

GENETIC ALGORITHMS

Basics of GA- choice of encoding-selection probability-mutation and crossover-fitness evaluation - improving convergence rate-a simplex GA- Hybrid approach.

UNIT V **9 Hours**

APPLICATIONS OF SOFT COMPUTING

Fuzzy techniques for inverted pendulum case- MISO rule model-SIRM fuzzy systems- Aggregation operators for decision making - MCDM for weather forecasting.

FOR FURTHER READING

MCDM for financial marketing-Neural networks for TS problems-Routers - GA application to metabolic modeling.

Total: 45 Hours

Reference(s)

1. Jang J.S.R.,Sun C.T and Mizutani E,Neuro Fuzzy and Soft computing, Pearson Education (Singapore), 2006.
2. David E.Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, Asia, 2001.
3. Timothy J.Ross, Fuzzy Logic Engineering Applications, McGrawHill, NewYork, 2002.
4. S.Rajasekaran and G.A.Vijayalakshmi Pai, Neural networks, Fuzzy logics and Genetic algorithms, Prentice Hall of India, 2003.
5. George J.Klir and Bo Yuan,Fuzzy Sets and Fuzzy Logic, Prentice Hall Inc., New Jersey, 2002.

15EC028 PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE TECHNIQUES

3 0 0 3

Course Objectives

- To understand different supervised and unsupervised learning techniques
- To obtain sound knowledge on recent advancement on pattern recognition techniques

Programme Outcomes (POs)

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

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

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

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

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

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

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

m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Identify and analyze the pattern recognition algorithms for classifications
2. Apply the unsupervised learning techniques for pattern classification

3. Explain the concepts of structural pattern recognition
4. Analyze the feature extraction and selection techniques
5. Analyze the advanced neural network structures for pattern recognition

Articulation Matrix

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

UNIT I **9 Hours**

PATTERN CLASSIFIER

Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm -Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.

UNIT II **9 Hours**

UNSUPERVISED CLASSIFICATION

Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm - Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III **9 Hours**

STRUCTURAL PATTERN RECOGNITION

Elements of formal grammars - String generation as pattern description - Recognition of syntactic description -Parsing - Stochastic grammars and applications.

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation -Binary feature selection.

UNIT V **9 Hours**

RECENT ADVANCES

Neural network structures for Pattern Recognition - Neural network based Pattern associators - Unsupervised learning in neural Pattern Recognition.

FOR FURTHER READING

Fuzzy logic - Fuzzy pattern classifiers for signal processing -Pattern classification using Genetic Algorithms.

Total: 45 Hours

Reference(s)

1. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley &Sons Inc., New York, 2007
2. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
3. Duda R.O., Hart.P.E., and Strok, Pattern Classification, second Edition Wiley, New York, 2008.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
5. IEEE Transaction on Pattern Recognition Techniques 2006.
6. IEEE Engineering Medicine and Biology Magazine 2006.

15EC029 AUTOMOTIVE SYSTEM DESIGN AND NETWORKING

3 0 0 3

Course Objectives

- To analyze the fundamental concepts of automotive systems
- To analyze the characteristics of automotive sensors and actuators
- To differentiate various automotive networking architecture in new generation vehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Design and analyse the basic control mechanism of automotive system
2. Analyse the functionalities of automotive sensors
3. Analyse the control mechanism of automotive actuators in modern vehicles
4. Differentiate various vehicular electronics control unit in automotive systems
5. Explain the various networking topologies in new generation automotive systems

Articulation Matrix

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

UNIT I **8 Hours**

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Automobile systems: Engine and its control - Ignition systems - Steering systems - Control systems: proportion controller, Proportional Integral controller and Proportional Integral differential controller

UNIT II **10 Hours**

AUTOMOTIVE SENSORS

Sensor basics & its Functions - Air mass flow sensor - Crankshaft angular position sensor - Throttle valve sensor - Eddy current sensors - Hall sensors - Ultrasound sensor - GPS and distance traveled measurement

UNIT III **9 Hours**

AUTOMOTIVE ACTUATORS

Fuel Injectors - Exhaust gas recirculation Actuator - Electronic Ignition sub-systems - Digital Engine control systems: Speed density method - Idle speed control method- EGR control - Distributor-less Ignition control

UNIT IV **9 Hours**

VEHICULAR ELECTRONICS ARCHITECTURE

Intelligent Power distribution module - Supplemental restraint systems - Body control module - Engine control modules - Automatic drive positioned control unit - Driver seat control module - Front air control unit and transmission control unit

UNIT V **9 Hours**

AUTOMOTIVE NETWORKING

Networking basics topologies - Addressing - Control mechanisms: Event control & Timer control - Network topologies for new generation vehicles - Bus systems: CAN Bus, High speed CAN, LIN bus, MOST bus, Bluetooth: Piconet and scatternet

FOR FURTHER READING

Electronic management of chassis systems, Vehicle motion control, anti - lock braking system, Tyre pressure monitoring system, Collision avoidance system, Traction control system, Active suspension system Key less entry system and Electronic power steering system

Total: 45 Hours

Reference(s)

1. William Ribbens-Understanding Automotive Electronics, Fifth Edition-Newnes (1998)
2. Konrad Reif -Automotive Mechatronics_ Automotive Networking, Driving Stability Systems, Electronics-Vieweg-Teubner Verlag (2015)

3. Najamuz Zaman (auth.)-Automotive Electronics Design Fundamentals-Springer International Publishing (2015)
4. Robert Bosch GmbH, Bosch Automotive Electrics and Automotive Electronics_ Systems and Components, Networking and Hybrid Drive-Springer Vieweg (2014)
5. W.H.Crouse ,Automobile Electrical Equipment, McGraw-Hill, (1996)
6. P.L.Kholi, Automotive Electrical Equipment, Tata McGraw-Hill, (1995)

15EC030 WIRELESS CELLULAR AND LTE 4G BROADBAND

3 0 0 3

Course Objectives

- To understand the basics of LTE standardization phases and the system architecture of LTE and E-UTRAN, the layer of LTE, based on the use of OFDMA and SC-FDMA principles.
- To understand the role of LTE radio interface protocols to set up, reconfigure and release the Radio Bearer, for transferring the EPS bearer.
- To remember the main factors affecting LTE performance including mobile speed and transmission bandwidth.

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Identify the system architecture and the functional standard specified in LTE 4G.
2. Analyze the role of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from users.
3. Demonstrate the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
4. Analyze the Uplink Channel Transport Processing and Physical Layer Procedures.
5. Test and Evaluate the Performance of resource management and packet data processing and transport algorithms.

Articulation Matrix

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

UNIT I **9 Hours**

KEY ENABLERS FOR LTE FEATURES

OFDM, Single carrier FDMA, Single carrier FDE, Channel Dependant Multiuser Resource Scheduling, Multiantenna Techniques, IP based Flat network Architecture, LTE Network Architecture. Wireless Fundamentals: Cellular concept, Broadband wireless channel (BWC), Fading in BWC, Modeling BWC - Empirical and Statistical models, Mitigation of Narrow band and Broadband Fading.

UNIT II **9 Hours**

MULTICARRIER MODULATION

OFDM basics, OFDM in LTE, Timing and Frequency Synchronization, PAR, SC-FDE. OFDMA and SC-FDMA: OFDM with FDMA, TDMA, CDMA, OFDMA, SC-FDMA, OFDMA and SC-FDMA in LTE. Multiple Antenna Transmission and Reception: Spatial Diversity overview, Receive Diversity, Transmit Diversity, Interference cancellation and signal enhancement, Spatial Multiplexing, Choice between Diversity, Interference suppression and Spatial Multiplexing.

UNIT III **9 Hours**

OVERVIEW AND CHANNEL STRUCTURE OF LTE

Introduction to LTE, Channel Structure of LTE, Downlink OFDMA Radio Resource, Uplink SC-FDMA Radio Resource. Downlink Transport Channel Processing: Overview, Downlink shared channels, Downlink Control Channels, Broadcast channels, Multicast channels, Downlink physical channels, H-ARQ on Downlink.

UNIT IV **9 Hours**

UPLINK CHANNEL TRANSPORT PROCESSING

Overview, Uplink shared channels, Uplink Control Information, Uplink Reference signals, Random Access Channels, H-ARQ on uplink. Physical Layer Procedures: Hybrid - ARQ procedures, Channel Quality Indicator CQI feedback, Precoder for closed loop MIMO Operations, Uplink channel sounding, Buffer status Reporting in uplink, Scheduling and Resource Allocation, Cell Search, Random Access Procedures, Power Control in uplink.

UNIT V **9 Hours**

RADIO RESOURCE MANAGEMENT AND MOBILITY MANAGEMENT

PDCP overview, MAC/RLC overview, RRC overview, Mobility Management, Inter-cell Interference Coordination.

Total: 45 Hours

Reference(s)

1. Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Fundamentals of LTE, Prentice Hall, Communications Engg and Emerging Technologies.

2. LTE for UMTS Evolution to LTE-Advanced , Harri Holma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.
3. EVOLVED PACKET SYSTEM (EPS) ; THE LTE AND SAE EVOLUTION OF 3G UMTS, by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN:978-0-470-05976-0
4. LTE - The UMTS Long Term Evolution ; From Theory to Practice, by Stefania Sesia, IssamToufik, and Matthew Baker, 2009 John Wiley & Sons Ltd, ISBN 978-0-470-69716-0.

15EC031 MACHINE LEARNING 3 0 0 3

Course Objectives

- To Apply the Machine learning concepts for real-time problems.
- To implement machine learning techniques and computing environment that is suitable for the applications under consideration.
- To apply scaling up machine learning techniques and associated computing techniques and technologies.

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. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Design machine learning systems.
2. Implement probabilistic discriminative and generative algorithms for regression and classification problems and analyze the results.
3. Implement an unsupervised algorithm to predict the continuous and categorical data and analyze the results.
4. Implement machine learning algorithms and solve real-world problems.
5. Generate machine learning model for regression and classification problems.

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

UNIT I **7 Hours**

INTRODUCTION

Introduction-Definitions, types of learning, designing learning systems, issues in machine learning, -hypothesis space and inductive bias, evaluation, cross-validation.

UNIT II **10 Hours**

SUPERVISED LEARNING

Regression-Linear and multilinear regression, polynomial, decision trees, random forest. Classification-k-nearest neighbor algorithm, Classification and Regression Tree, logistic regression, Naive Bayes and SVM.

UNIT III **10 Hours**

UNSUPERVISED LEARNING

Clustering- k-means clustering and dimensionality reduction-singular value decomposition, principal component analysis,. Categorical-Association analysis, Apriori, Frequent pattern growth, Hidden Markov model.

UNIT IV **9 Hours**

NEURAL NETWORKS

Biological Motivation- McCulloch Pitts Neuron, Thresholding Logic, Perceptron, Perceptron Learning Algorithm, Multilayer Perceptron-Back propagation algorithm, Sigmoid Neurons, neural network representation, Gradient Descent, bagging and boosting.

UNIT V **9 Hours**

APPLICATION

Machine Learning Frame works- Scikit Learn, Tensor flow, Azure, Theano. Applications-Boston house price prediction, Face recognition, Iris Classification.

FOR FURTHER READING

Reinforcement Learning, Deep Learning Platform, Generative Adversarial Networks, Adversarial machine learning.

Total: 45 Hours

Reference(s)

1. Stephen Marsland, Machine Learning - An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.

3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Second edition, Springer series in Statistics.
4. https://dzone.com/articles/8-best-deep-learning-frameworks

15EC032 VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- Desing basic Virtual Instrumentation Systems using LabVIEW
- Interface DAQ systems with Computer through LabVIEW
- Analyze Signals using Virtual Instrumentation Systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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. PSO2: Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

Course Outcomes (COs)

1. Analyze the building blocks of a Graphical Programming Tool
2. Apply the concepts of loops and arrays to design simple GUI based applications using LabVIEW
3. Apply the concepts of Data Acquisition using DAQ Systems and interfacing it with PC
4. Design basic virtual instrumentation systems using LabVIEW
5. Analyze the signals using a Virtual Instrumentation System.

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTALS OF VIRTUAL INSTRUMENTATION

LabVIEW - graphical user interfaces- controls and Indicators - programming - data types - data flow programming - Editing Debugging and Running a Virtual Instrument- Graphical programming palettes and tools - Front panel objects.

UNIT II **9 Hours**

GRAPHICAL PROGRAMMING ENVIRONMENT IN VI

FOR Loops, WHILE loops, Shift Registers, CASE structure, formula nodes-Sequence structures- Arrays and Clusters- Array operations - Bundle, Unbundle - Bundle/Unbundle by name, graphs and charts - string and file I/O - High level and Low level file I/Os.

UNIT III **9 Hours**

INTERFACING DAQ SYSTEM WITH PC

Basics of DAQ Hardware and Software - Concepts of Data Acquisition and terminology - Installing Hardware, Installing drivers -Configuring the Hardware - addressing the hardware in LabVIEW- Digital and Analog I/O function - Buffered I/O.

UNIT IV **9 Hours**

SIMPLE PROGRAMMING IN VI

Simple programs in VI- Advanced concepts in LabVIEW- TCP/IP VIs , Synchronization - other elements of Virtual Instrumentation - Bus extensions - PXI - Computer based instruments.

UNIT V **9 Hours**

ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI

Fourier transform - Power spectrum - Filtering tools - CRO emulation - Audio signal processing using Signal processing toolkit-Virtual instrumentation application in Biomedical, Process Control and Mechatronics.

FOR FURTHER READING

Function and Libraries. Attribute nodes local and global variables. Real time Data Acquisition. Image acquisition and Motion Control. Different connectivity and data communication.

Total: 45 Hours

Reference(s)

1. Jovitha Jerome, Virtual Instrmentation using LabVIEW, PHI, 2010
2. Garry M. Johnson, LabVIEW Graphical Programming, Tata McGraw Hill, 1996.
3. Labview Basics I and II Manual, National Instruments.
4. Barry Paton, Sensor, Transducers and LabVIEW, PHI, 2000.
5. Lisa K Wlls, LabVIEW for Everyone,PHI,1996

ENTREPRENEURSHIP ELECTIVES

15GE001 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- To 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

Course Outcomes (COs)

1. Able to gain Knowledge about entrepreneurship, motivation and business.
2. Able to develop small scale industries in different field.

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractionation, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

FOR FURTHER READING

Role of social networking sites in business

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

Assessment Pattern

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

Assessment Questions

Remember

1. What is entrepreneurship?
2. What are the factors that motivate people to go into business?
3. Define a small-scale industry
4. Who is an intrapreneur?
5. State functions of SISI
6. What is serial entrepreneur?
7. What is Technopreneurship?
8. What is reversal method?
9. What is brainstorming?
10. What do you mean by term business idea?
11. Mention any two schemes Indian government provides to the development of entrepreneurship
12. What is a project report?
13. What is project scheduling?
14. Mention any four techniques available for project scheduling.
15. What is contract act?
16. Define MOU.
17. Mention any five external sources of finance to an entrepreneur.
18. Classify the financial needs of an organization
19. Why is motivational theories important for an entrepreneur?

Understand

1. Why is entrepreneurship important of growth of a nation?
2. Mention the essential quality required for someone to be an entrepreneur.
3. How is network analysis helpful to the development of an entrepreneur?
4. Mention the essential requirements for a virtual capital.
5. How under-capitalization affects an entrepreneur
6. Mention the causes of dissolution of a firm.
7. How important is the support of IDBI to an entrepreneur?
8. What are the salient features of New Small Enterprise Policy, 1991?
9. Why scheduling is very important for a production design?

Apply

1. If you want to become as an entrepreneur, what will be your idea?
2. Select any one of the creative idea generation method and suggest an innovation that you can implement in your business.
3. Write short notes on various legal aspects that you have to consider to run you business.
4. How will you generate your capital and other financial supports?

5. In case of getting enough financial support, plan your business and plot the various stages using any of the tools or techniques

Create

1. Draft a sample project report for your business
2. Do a network analysis using PERT and CPM for your business plan.
3. Write a brief report to apply to a financial organization for seeking financial support to your business

15GE002 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- To Evolve the marketing mix for promoting the product / services
- To Handle the human resources and taxation
- To Understand Government industrial policies / support provided and prepare a business plan

Course Outcomes (COs)

1. Increase in awareness of the entrepreneurship Development for engineering decisions.

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.

FOR FURTHER READING

Ethics in Entrepreneurship

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.htm

Assessment Pattern

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

Assessment Questions

Remember

1. Who is Fabian Entrepreneur?
2. Mention the three functions of NSIC?
3. Narrate the role of IDBI in the development of Entrepreneurship?
4. What are the stages in a Project Lifecycle?
5. Give the meaning of Feasibility Report
6. What is Motivating Training?
7. Who is a Small Scale Entrepreneur?
8. How to develop Rural Entrepreneur?
9. What are the Social Problems of Women Entrepreneur?
10. What are the types of entrepreneurs?
11. List the various qualities of entrepreneur.
12. What is entrepreneurship training?
13. State the role of NISIET.
14. List the challenges and opportunities available in SSI's?

Understand

1. What are the elements of EDP?
2. How would you Classify Projects?
3. What is the role played by commercial banks in the development of entrepreneur?
4. What are the target groups of EDP?
5. What are the major problems faced by Small Entrepreneur?
6. What are the problems & prospects for women entrepreneur in India?

Apply

1. Describe the various functions performed by Entrepreneurs?
2. Explain the role of different agencies in the development of Entrepreneur?
3. Discuss the criteria for selecting a particular project?
4. Describe the role of Entrepreneur in the Development of Country?
5. Define business idea. Elaborate the problems and opportunities for an entrepreneur.

6. Elaborate the schemes offered by commercial banks for development of entrepreneurship.
7. Explain the significant role played by DIC & SISI for the development of entrepreneurship.

Analyse

1. Differentiate between entrepreneur and entrepreneurship
2. What are the problems of Women entrepreneurs and discuss the ways to overcome these barriers?
3. Discuss the importance of small scale industries in India

Evaluate

1. Review the entrepreneurial growth by the communities of south India.
2. Critically examine the growth and development of ancillarisation in India.

Create

1. Design a short entrepreneurship development programme for farmer.
2. "All economy is the effect for which entrepreneurship is the cause"-Discuss.
3. Discuss the various sources and collection of credit information of entrepreneurs
4. Discuss the role of the government both at the Central and State level in motivating and developing entrepreneurship in India.
5. Briefly explain the recommendation and policy implication for survival of SME's.
6. Developing countries like India need imitative entrepreneurs rather than innovative entrepreneurs". Do you agree? Justify your answer with examples.
7. Discuss the "Culture of Entrepreneurship" and its role in economic development of a nation. What factors contribute to nurturing such a culture?

PHYSICAL SCIENCE ELECTIVES

15GE0P1 NANOMATERIALS SCIENCE

3 0 0 3

Course Objectives

- Understand the fundamentals of physics of nanomaterials
- Correlate on multidisciplinary branch
- Acquire the knowledge in nanomaterials synthesis, compile and analyze data and draw conclusions at nano level

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Classify the size dependant properties of different nanomaterials
2. Explain different experimental methods used for the preparation of nanomaterials
3. Analyse the data using different characterization techniques

4. Illustrate the different techniques to synthesize semiconductor nanostructures and utilize them for application
5. Identify the impact of nanomaterials and their applications in Nano devices

Articulation Matrix

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

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures,nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - magnetic properties of nanoscale materials -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - chemical vapour deposition, plasma enhanced CVD, colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization - DC sputtering and RF sputtering process.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials.

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED’s - basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- nano motors -bio nano particles-nano - objects - applications of nano materials in biological field.

FOR FURTHER READING

Application of graphene in various field - supercapacitors - third generation solar cell-dye sensitized solar cell (DSSC) -fuel cells.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007.
3. Guozhong Cao, Y. Wang, Nanostructures and Nanomaterials-Synthesis, Properties & Applications, Imperials College Press, 2011.
4. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw - Hill Education (India) Ltd, 2012.
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, Fuel cells: Principles and Applications, University Press, 2009.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1		4	4		2					4				3					4						21
2	2	3	4		4	4				3				4											24
3	2	4	2			2	2				2			2											16
4		2				2	4			2				4					3						17
5	2	4				3	2				4				4										19
																								Total	97

Assessment Questions

Remember

1. Explain the term nano
2. List three types of classifications of nanomaterials.
3. Recall the principle behind lithography.
4. Define top-down and bottom-up approach.
5. Name two types of nanoarchitecture
6. Define nanocomposites.
7. Recall the principle of electron microscopy.
8. List 5 characterization techniques in nanotechnology.
9. Define quantum well and quantum wire.
10. Write the allotropy of carbon.

Understand

1. Explain the effect of nanometer length scale.
2. Can affect the system total energy when particle size reduced? Justify.
3. Explain plasma enhanced CVD.

4. Identify the difference between self-assembly and self-organization.
5. Name 3 synthesis process under bottom-up approach.
6. Explain contact mode in AFM.
7. Is it possible to explain the entire details of the sample by taking one characterization technique? if no, justify.

Apply

1. Find three day to day live commercial application of nanotechnology?
2. Choose two template methods used to obtain nanowire or nanorods.
3. Construct the experimental setup for organic LED.
4. Find 4 industrial applications of CNT.

Analyse

1. Differentiate between bulk and nanomaterials.
2. Identify the roll of nanoparticles in biological field.
3. Distinguish between glow discharge and RF sputtering.
4. Criticize the future challenges for nanotechnology?

Evaluate

1. Nanomaterials, do they exist in nature? If yes, Identify the nanomaterials and recognize.

15GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Exemplify the drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the electric field and space charge width of PN junction under different biasing
3. Explain the charge flow, temperature effects, turn on and turn off transients in PN junction diode
4. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations.
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

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

UNIT I **9 Hours**

CARRIER TRANSPORT IN SEMICONDUCTORS

Carrier drift - drift current density - mobility effects on carrier density - conductivity in semiconductor - carrier transport by diffusion - diffusion current density - total current density - breakdown phenomena - avalanche breakdown.

UNIT II **9 Hours**

PHYSICS OF P-N JUNCTION

Basic structure-Built in potential barrier, Electric field and space charge width of P-N junction under zero, forward and reverse bias- Diffusion capacitance - one sided and linearly graded junctions.

UNIT III **9 Hours**

P-N JUNCTION DIODE

Qualitative description of charge flow in p-n junction - boundary condition - minority carrier distribution - ideal p-n junction current - temperature effects - applications - the turn on transient and turn off transient.

UNIT IV **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

Introduction to basic principle of operation - the modes of operation - amplification - minority carrier distribution in forward active mode - non-ideal effects - base with modulation - high injection emitter band gap narrowing - current clouding - breakdown voltage - voltage in open emitter configuration and open base configuration.

UNIT V **9 Hours**

OPTO ELECTRONIC DEVICES

Optical absorption in a semiconductor, photon absorption coefficient - electron hole pair generation - solar cell - homo junction and hetero junction - Photo transistor - laser diode, the optical cavity, optical absorption, loss and gain - threshold current.

FOR FURTHER READING

Organic semiconductors- diodes - transistors-working and applications

Total: 45 Hours

Reference(s)

1. Donald A Neamen, Semiconductor Physics and Devices, Tata McGraw Hill, 2012.
2. S. M. Sze and M. K. Lee, Semiconductor Devices, Physics and Technology, John-Wiley & Sons, 2015.

3. Ben. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, Pearson Education Ltd, 2015.
4. C. Kittel, Introduction to Solid State Physics, John-Wiley & Sons, 2012.
5. J. Millman and C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill, 2010.
6. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley-VCH, 2006.

Assessment Pattern

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

Assessment Questions

Remember

1. Define drift current density
2. Recall diffusion capacitance
3. Write the ideal diode equation
4. List the three modes of transistor operation
5. State the principle of solar cell

Understand

1. Identify the two scattering mechanisms that affect mobility of charge carriers in semiconductors
2. Sketch the energy band diagram of a P-N junction under thermal equilibrium
3. Exemplify the boundary conditions used to calculate minority carrier distribution in a junction diode
4. Explain the base width modulation occur in transistors
5. Illustrate the working mechanism of a phototransistor

Apply

1. By applying the concept of scattering, explain the mobility of holes in a semiconductor.
2. Apply Poission equation to space charge region and hence derive the electric field under zero bias
3. Show that the minority carrier concentrations in a diode decay exponentially with distance away from the junction to their thermal-equilibrium values.
4. Derive an expression for excess minority current in the emitter region under forward action mode by applying the ambipolar transport equation.
5. Show that the minority carrier concentrations in a diode decay exponentially with distance away from the junction to their thermal-equilibrium values.

Analyse

1. Differentiate drift current and diffusion current
2. Space charge width increases upon reverse bias. Justify
3. Silicon is preferred over germanium for the manufacture of semiconductor devices. Justify
4. Compare emitter bandgap narrowing and current crowding.
5. Differentiate homojunction and heterojunction laser.

15GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. 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
1	2	1										
2	2	1										
3	2											
4	2											
5	2											

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - Einstein's prediction - spontaneous emission - stimulated emission - Einstein's relations - A and B coefficients - population inversion - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification. Components of lasers: active medium - pumping - pumping mechanisms - resonant cavity.

UNIT II **9 Hours**

CHARACTERISTICS AND TYPES OF LASERS

Introduction - directionality - intensity - coherence - monochromaticity. Classification of lasers - principle, construction, working, energy level diagram and applications of CO_2 laser - dye laser - excimer laser - Nd:YAG laser - semiconductor laser.

UNIT III **9 Hours**

LASERS IN SCIENCE

Harmonic generation - stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - LIGO - rotation of the earth - measurement of distance - velocity measurement - holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Eye laser surgery - LASIK - photocoagulations - light induced biological hazards: Eye and skin - homeostasis - dentistry - laser angioplasty - laser endoscopy - different laser therapies.

UNIT V **9 Hours**

LASERS IN INDUSTRY

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

FOR FURTHER READING

Q-switching - mode locking - thermo-optic effects - astronomy lasers - fighting crime with lasers - laser engraving.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015.
2. M. N. Avadhanulu, An Introduction to Lasers Theory and Applications, S. Chand Publisher, 2013.
3. W. Koechner, M. Bass, Solid State Lasers: a graduate text, Springer Verlag, New York, 2006.
4. K. P. R. Nair, Atoms, Molecules and Lasers, Narosa Publishing House, 2009.
5. K. R. Nambiar, Lasers: Principles Types and Applications, New Age International Publications, 2006.
6. A. Sennaroglu, Solid-State Lasers and Applications, CRC Press, 2006.

Assessment Pattern

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

Assessment Questions

Remember

1. Recognise the term LASER
2. Define stimulated absorption
3. Define spontaneous emission

4. Define stimulated emission
5. Distinguish between spontaneous and stimulated emission
6. State population inversion
7. List the four characteristics of lasers
8. Mention the five medical applications of lasers
9. State the principle behind the holography
10. Recall the term resonant cavity

Understand
1. Identify the condition needed for laser action
2. Interpret the pumping of atoms
3. Exemplify the optical excitation occurs in three level laser systems
4. Explain the determination of rotation of earth using laser
5. Summarize the application of lasers in welding and cutting
6. Explain the term LASIK
7. Classify the different types of lasers based on materials
8. Illustrate the working of laser in material processing

Apply
1. Predict the condition for laser action
2. Derive the Einstein's A and B coefficients
3. Deduce the expression for large stimulated emission
4. Construct the experimental setup for distance measurement
5. Find the applications of lasers in stimulated Raman
6. Assess the wavelength of emission of GaAs semiconductor laser whose bandgap energy is 1.44 eV.

Analyse
1. Laser beam should be monochromatic, Justify?
2. Differentiate ordinary light source from laser source
3. Compare the working of gas lasers with excimer laser
4. Four level laser systems are more efficient than three level laser systems. Justiify**?**

Evaluate
1. Determine the intensity of laser beam be focused on an area equal to the square of its wavelength. For He-Ne laser wavelength is 6328 A^0 and radiates energy at the rate of 1mW.
2. Choose the appropriate lasers for the materials processing in industry

15GE0C1 CORROSION SCIENCE 3 0 0 3

Course Objectives
- Recognize the terminologies used in corrosion science.
- Impart knowledge about the various types of corrosion and its mechanism.
- Understand the various methods of corrosion control, corrosion testing and monitoring.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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.
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. Evaluate if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 c)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

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

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - passivation - direct and indirect damage by corrosion - importance of corrosion prevention in industries - area relationship in both active and passive states of metals - Pilling Bedworth ratio and its significance - units of corrosion rate (mdd and mpy) - importance of pitting factor - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages.

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion. High temperature oxidation, kinetics of protective film formation and catastrophic oxidation corrosion.

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - cracking - corrosion fatigue - filliform corrosion - fretting damage and microbes induced corrosion - corrosion mechanism on steel, iron, zinc and copper metal surfaces - thick layer and thin layer scale formation - in situ corrosion scale analysis.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: factors affecting corrosion - electrochemical methods of polarization - Tafel extrapolation polarization, linear polarization, impedance techniques - weight loss method - susceptibility test - testing for intergranular susceptibility and stress corrosion. Visual testing - liquid penetrant testing - magnetic particle testing - eddy current testing.

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection.Stray current corrosion problems and its prevention. Protective coatings: anodic and cathodic coatings - metal coatings: hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of sacrificial anode for corrosion control.

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems.

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, Introduction to Corrosion Engineering, CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, Singapore, 2008.
5. David E.J. Talbot (Author), James D.R. Talbot, Corrosion Science and Technology, Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

Assessment Pattern

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

Assessment Questions

Remember

1. Define Corrosion
2. Mention the five types of corrosion
3. Define dry corrosion. Explain the mechanism.
4. What are corrosion inhibitors? Give two examples.
5. What are corrosion inhibitors? Give two examples.
6. Write the working principle of Tafel polarization techniques.
7. How polarization and impedance techniques are used to measure the corrosion products?
8. Define cathodic protection.
9. Ellaborate non-electrochemical and electrochemical methods of corrosion testing and monitoring.
10. What is Tafel linear polarization?

Understand

1. Explain the mechanism of electrochemical corrosion.
2. Identify the relation between the two units used to measure corrosion rate.
3. Illustrate the Pourbaix digrams of Mg/Al/Fe and their limitations.

4. List the eight forms of corrosion. Explain each type with an example.
5. What are the factors influencing the corrosion rate? Explain.
6. Discuss the Pilling-Bedworth rule.
7. Differentiate between electrochemical and dry corrosion.
8. How inhibitors are used to protect the corrosion rate of the metal? Explain.
9. What are consequences of Pilling-Bedworth ratio?
10. List the difference between filliform corrosion and pitting corrosion.

Apply

1. Area relationship between the anodic and cathodic part in galvanic corrosion. Discuss.
2. Describe alternatives to protective coatings.
3. How Tafel polarization and impedance techniques used to measure the corrosion products?

Analyse

1. Explain why corrosion rate of metal is faster in aqueous solution than atmosphere air?
2. Why pitting corrosion is localized corrosion? Explain.
3. Compare the effects of corrosion products.
4. Identify different forms of corrosion in the metal surface.
5. What are the major implications of enhanced techniques of corrosion product analysis?

15GE0C2 ENERGY STORING DEVICES AND FUEL CELLS

3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles.
- Identify the types of fuel cells and to relate the factors of energy and environment.
- Analyze various energy storage devices and fuel cells.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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.

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

Course Outcomes (COs)

1. Analyze the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Identify different methods for the production of hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of practical batteries - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries- zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells.

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - biomass pyrolysis -gas clean up - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy - life cycle assessment of fuel cell systems. Solar Cells: energy conversion devices, photovoltaic and photoelectrochemical cells - photobiochemical conversion cell.

FOR FURTHER READING

Energy conservation, Over utilization, Energy demanding activities.

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009.
2. F. Barbir,PEM fuel cells: Theory and practice,Elsevier, Burlington, MA, Academic Press, 2013.

3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001.
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012.
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016.
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2			1	2	2			1			1	3				1							15
2	4	1			4	5	2			2			1	2				1							22
3	3				4	6	2		1	3			1	1				1							22
4	1	2			4	4	1			4			2	4											22
5	2	2			2	5				3			2	3											19
																								Total	100

Assessment Questions

Remember

1. How galvanic cell is differing from electrolytic cell?
2. How is the potential of an electrochemical cell calculated?
3. List any four characteristics of primary batteries.
4. Mention any two characteristics and applications of zinc-carbon battery.
5. Recognize any two applications and characteristics of primary magnesium batteries.
6. Identify the applications and characteristics of Zn/HgO primary batteries.
7. Indicate any two applications of Zn/alkaline/MnO_2 battery.
8. Mentioned any two applications of Zn/Ag_2O primary battery.
9. Define capacity of a cell
10. Define discharge rate of a battery.
11. Describe the construction, cell reaction and applications of zinc-carbon battery.
12. Explain the construction, chemistry, advantages and uses of mercuric oxide battery.
13. Explain the major components and reaction of direct methanol fuel cell. List two applications.
14. Explain the working principle, components and applications of alkaline fuel cells
15. Discus the conversion of sunlight into electrical power in photoelectrochemical cells.

Understand

1. Mention the five different types of energy storage devices
2. Define the term battery
3. List any two differences between battery and cell.
4. Mention the three major components of cell.
5. Classify the batteries based on their cell reversibility.
6. Define cycle Life of a cell.
7. Explain the construction, cell reaction and applications of silver oxide batteries.
8. With a neat sketch explain the construction and working of phosphoric acid fuel cell.
9. Explain the major components and reactions of direct methanol fuel cell
10. Explain the production of hydrogen photobiochemical conversion cell.

Apply

1. Specific gravity is an indicator of charge in lead acid battery – Justify.
2. Illustrate the process of water electrolysis for the production of hydrogen.
3. How is the potential of an electrochemical cell calculated?

4. How is the potential of an electrochemical cell calculated?

Analyse

1. In the mid-winter car battery is not working –reason out.
2. Discuss the hydrogen energy strategies for sustainable development.
3. How galvanic cell is differing from electrolytic cell?
4. How batteries are rated?
5. Differentiate between primary and secondary batteries.

15GE0C3 POLYMER CHEMISTRY AND PROCESSING

3 0 0 3

Course Objectives

- Impart knowledge on the basic concepts of polymers and its mechanism
- Use the appropriate polymerization techniques to synthesize the polymers and its processing
- Select the suitable polymers for various applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

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

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical polymerization -

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

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation.

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties by TGA and DSC, Testing tensile strength, Izod impact, Compressive strength, Rockwell hardness, Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption.

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plactics fabrication: hand-layup - filament winding and pultrusion.

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration.

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International (P) Ltd., New Delhi, 2015.
2. Joel R. Fried, Polymer Science and Technology, Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, Polymer Analysis, John Wiley & Sons, New York, 2008
5. George Odian , Principles of Polymerization, John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, Introduction to Polymers, CRC Press, New York, 2011

Assessment Pattern

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

Assessment Questions

Remember

1. Recall two factors that govern termination of cationic polymerization.
2. Identify the monomers used in styrene -butadiene rubber.
3. Give an examples for the thermosetting and thermoplastic polymers.
4. What is copolymerization? Give an example
5. Name two synthetic polymers which are used for making textile fibres.
6. Define the role of Ziegler – Natta catalysts
7. List the examples of Ziegler – Natta catalysts.
8. Identify the four types of polymerization technique.
9. List any two disadvantages of suspension polymerization.
10. Point out the advantages of bulk polymerization technique.
11. Why does natural rubber need compounding?
12. List any four applications of injection moulding process.
13. List the various additives in processing of plastics.
14. List the two properties of heat resistant polymers .
15. Mention the application of flame retardant polymers.

Understand

1. Classify the polymers based on source
2. Discuss the addition and chain growth polymerization with example
3. Compare addition and condensation polymerization reaction with example for each type .
4. Explain homogeneous and heterogeneous polymerization.
5. Explain the mechanism involved in addition polymerization of vinylChloride
6. Explain the condensation polymerization method taking nylon 6,6,nylon synthesis as a representative example.
7. Discuss the preparation method and any three properties of Polysulphone.
8. Summaries the salient features, advantages and disadvantages of bulk and emulsion polymerization techniques.
9. Compare the homogeneous and heterogeneous polymerization method.
10. With a neat sketch, discuss the functioning of melt, dry and wet spinning process.
11. Illustrate the compression and extrusion moulding of plastics with diagram neat diagram.
12. Explain the coordination polymerization mechanism using a sutable example.

Apply

1. Relate the various steps involved in anionic and cationic polymerisation using suitable examples.
2. Select the suitable polymerization techniques for synthesis of PMMA and SBR

3. Assess the characterisation techniques used to find the structure of polymer .
4. Find the method to process the composite materials with example.
5. Execute the filament – winding Technique for manufacturing of rocket motor bodies.

Analyse

1. Distinguish between addition and condensation polymerisation.
2. Natural rubber need vulcanization –Justify.
3. Compare the salient features, advantages and disadvantages of solution and suspension polymerization techniques.
4. Bring out the differences between thermoforming and vacuum-forming process.
5. Outline the applications of polymer in controlled drug delivery and artificial organs.

Evaluate

1. Judge the biomedical applications of polymers in Hemo dialysis and hemo filtration.
2. Choose the suitable moulding Technique for polyvinyl chloride.

OPEN ELECTIVES

15EC0YA 4G AND BEYOND 3 0 0 3

Course Objectives

- To give a sound technical introduction to 4G and beyond wireless systems
- To study the properties of various Multiple Access Techniques
- To discuss the key concepts and principles of devices used in the network design

Programme Outcomes (POs)

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

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

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

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

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

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

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

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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Identify the trends and challenges in the 4G network design
2. Analyze the multiple access techniques used in 4G network
3. Analyze the channel modelling with its configurations for 4G Network
4. Apply the suitable mobile usage Scenarios according to the Network Capacity
5. Describe the evolution of mobile devices and operating systems with system architecture

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTALS

Trends and Challenges of the Emerging Wireless Networks - 4G Networks and Composite Radio Environment -Protocol Boosters - Hybrid 4G Wireless Network Protocols -Green Wireless Networks - Wireless Multimedia (4G and Beyond)

UNIT II **9 Hours**

PHYSICAL LAYER AND MULTIPLE ACCESS

Advanced Time Division Multiple Access-ATDMA - Code Division Multiple Access - Orthogonal Frequency Division Multiplexing - Multi carrier CDMA - Ultra Wide Band Signal - MIMO Channels and Space Time Coding - LTE

UNIT III **9 Hours**

CHANNEL MODELING FOR 4G

Macrocellular Environments (1.8 GHz) - Urban Spatial Radio Channels in Macro/MicroCell Environment (2.154 GHz) - MIMO Channels in Micro- and PicoCell Environment (1.71/2.05 GHz) - Outdoor Mobile Channel (5.3 GHz) - Microcell Channel (8.45 GHz) - Wireless MIMO LAN Environments (5.2 GHz) - Indoor WLAN Channel (17 GHz) - Indoor WLAN Channel (60 GHz) - UWB Channel Model

UNIT IV **9 Hours**

NETWORK CAPACITY AND USAGE SCENARIOS

Usage in Developed Markets and Emerging Economies - How to Control Mobile Usage -Measuring Mobile Usage from a Financial Point of View - Cell Capacity in Downlink - Current and Future Frequency Bands for Cellular Wireless - Cell Capacity in Uplink - Per-User Throughput in Downlink - Per-User Throughput in Uplink - Traffic Estimation Per User - Overall Wireless Network Capacity - Network Capacity for Train Routes, Highways, and Remote Areas - When will GSM be Switched Off - Cellular Network VoIP Capacity - Wi-Fi VoIP Capacity - Wi-Fi and Interference - Wi-Fi Capacity in Combination with DSL, Cable, and Fiber - Backhaul for Wireless Networks - A Hybrid Cellular/Wi-Fi Network Today and in the Future

UNIT V **9 Hours**

VOICE OVER WIRELESS AND MOBILE DEVICES

Circuit-Switched Mobile Voice Telephony - Packet-Switched Voice Telephony - Over-the-Top (OTT) Voice over IP Alternatives - Evolution of Mobile Devices and Operating Systems - The System Architecture for Voice-Optimized Devices and Multimedia Devices - Feature Phone Operating Systems 280 5.11 Smartphone Operating Systems

FOR FURTHER READING

Internet of Things: From Real to Virtual World - Communication Issues in the Internet of Things (IoT) - Machine-to-Machine Communications - Security in Emerging 4G Networks -Future of Wireless Technologies 5G, 6G and 7G.

Total: 45 Hours

Reference(s)

1. Savo G. Glisic , Advanced Wireless Networks - 4G Technologies John Wiley & Sons Ltd,
2. Martin Sauter, "3G, 4G and Beyond: Bringing Networks, Devices and the Web Together" Wiley , 2nd Edition,2013.
3. Chilamkurti, Naveen, Zeadally, Sherali, Chaouchi, Hakima, "Next-Generation Wireless Technologies - 4G and Beyond" Springer
4. Sassan Ahmadi, "LTE-Advanced: A Practical Systems Approach to Understanding 3GPP LTE Releases 10 and 11 Radio Access Technologies" 1st Edition ,Elsevier
5. Rukmani Khutey, Ghankuntla Rana et.al , "Future of Wireless Technology 6G & 7G" published in International Journal of Electrical and Electronics Research ,Vol. 3, Issue 2, pp: (583-585), Month: April - June 2015, ISSN 2348-6988 (online) Available at: www.researchpublish.com
6. Villiers - mark 2g, 3g, 5g, 6g, 7g, 8g, two- stroke engines -operation instructions and spare parts list, Publisher: 1959 Villiers Engineering UK.

Assessment Pattern

Unit/RBT	Remember				Understand				Apply				Analyse				Evaluate				Create				Total
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	
1	2	2					6				4				6										20
2		2				4					4			4					8						22
3	2					4				4				4											14
4	2					2					6			4					8						22
5		2				2				8				4				6							22
																								Total	100

Assessment Questions

Remember

1. State the concept behind composite radio environment.
2. List the four categories of radio access technology.
3. Mention the components of a heterogeneous wireless access infrastructure.
4. List out the control messages used in direct transmission method.
5. Recall the method to increase the capacity in 4G networks.
6. Label the properties of sound signals used in macrocellular environments.
7. State the Channel azimuth-delay spread function at the Base station.

8. State the prerequisite for the applicability of the synthetic aperture technique in macrocellular environments.
9. In remote areas, when the GSM will be switched off.
10. Retrieve about Internet of things.

Understand

1. Write short notes on 3G mobile networks.
2. Illustrate composite radio environment in 4G networks.
3. Identify the two basic types of WLAN structure.
4. Indicate the Transition diagram for transmission mode and explain.
5. Illustrate about TDMA time slot for GSM and for American Digital Cellular system.
6. Explain the basic concept behind the Orthogonal Frequency Division Multiplexing.
7. Represent three different classes of clusters.
8. Summarize the track and spin measurement procedure of 60 GHz Indoor WLAN Channel.
9. Interpolate the operating system of smart phone.
10. Extrapolate about future Hybrid Cellular/Wi-Fi Network.

Apply

1. Predict the features of Ultra Wide Band signal.
2. Find the methods to solve the base station failure problem.
3. Predict the method to suppress antenna radiation towards the user.
4. Demonstrate the spatio-temporal channel characterization in a suburban non-line-of-sight microcellular environment.
5. Design the System Architecture for Voice-Optimized Devices and Multimedia Devices.
6. Predict the mobile usage from a Financial Point of View.
7. Compute the Cell Capacity in UPlink and Downlink.
8. Compute the Per-User Throughput in UPlink and Downlink.
9. Assess the operating systems of feature Phone.

Analyse

1. Conclude the architecture of a terminal that is capable of operating in a composite radio environment.
2. Organize the need for protocol booster.
3. Justify the execution of hand off in direct transmission mode.
4. Outline the power allocation schemes in both picocell and microcell environments.
5. Compare the performance of GSM, UMTS, and LTE networks.
6. Resolve the Communication Issues in the Internet of Things.
7. Conclude the method to Control Mobile Usage.
8. Compare the performance of Circuit-Switched Mobile Voice Telephony with Packet-Switched Voice Telephony.

Evaluate

1. Determine the path loss and received signal power in Indoor WLAN Channel.
2. Criticise how increase in network capacity could affect usage in the future.
3. Criticise VoIP Capacity in Cellular Network.

Create

1. Argue the possibility of a mobile handset to make a handoff between different RATs.
2. Relate the boosters required for UDP, TCP/IP.

15EC0YB MEDICAL APPLICATIONS OF LASER 3 0 0 3

Course Objectives

- Understand the applications of unique properties of laser in the medical field.
- Explore the usage of laser in the thermal and non thermal processes.

- Acquire knowledge about the protection standards required for laser operation.

Programme Outcomes (POs)

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

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

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

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

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

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

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. PSO1: Able to design new concepts in the domains of Microelectronics and Communication Engineering.

Course Outcomes (COs)

1. Differentiate the types of laser interaction and its associated processes.
2. Identify the type of laser, focussing system, experimental methods required for the particular medical application
3. Analyze different thermal applications of laser in the medical field.
4. Apply the non-thermal usage of laser in biological and medical fields
5. Implement correct degree of safety regulation while operating with different lasers.

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTALS OF LASER-TISSUE INTERACTION

Laser Characteristics as applied to medicine and biology - Laser tissue interaction - Photo physical process - Photo biological process - Absorption by biological systems - Different types of interaction - Thermal photochemical (one photon and multi photon) - Electromechanical - Photo ablative processes

UNIT II **9 Hours**

PHOTOBIOLOGY AND MEDICAL LASERS

Study of biological functions - Micro radiation of cells - optical properties of tissues (normal and diseased state) - Experimental methods to determine the reflectance, absorption, transmittance and emission properties of tissues - Laser systems in medicine and biology - Nd:YAG, Ar ion, CO2, Excimer, N2- Beam delivery and measuring systems.

UNIT III **9 Hours**

THERMAL APPLICATIONS

Surgical applications of lasers - Sterilization - hermostasis - Cancer Liver stomach gynecological surgeries - Performance evaluation - Lasers in Opthalmology - Dermatology and Dentistry - Cosmetic Surgery.

UNIT IV **9 Hours**

NON THERMAL APPLICATIONS

Trace element detection - Laser induced fluorescence studies - Cancer diagnosis - Photo radiation therapy of tumors - Lasers in endoscopy- Lasers in laproscopy - Lasers in trapping of cells and genetic engineering - Bio simulation - Holographic application of lasers in biology and medicine.

UNIT V **9 Hours**

SAFETY REGULATIONS

Protection standards for lasers - Safety regulation - Specific precautions- Medical surveillance.

FOR FURTHER READING

Gold Vapour laser - Beam delivery and measuring systems- speckle application of lasers in biology and medicine -Adverse effects of improper laser usage- Advancements in the laser delivery system.

Total: 45 Hours

Reference(s)

1. Martellucci. S. S., and Chester. A.N., 'Laser Photobiology and Photomedicine' Plenum Press, New York, 1985.
2. Pratesi. R., and Sacchi. C.A., 'Lasers in Photomedicine and Photobiology', Springer verlag, West Germany, 1980.
3. Carruth JAS & AL Mckenzie, 'Medical Lasers Science and Clinical Practice', Adam Hilger Ltd., Bristol, 1991.
4. Kaluylu. T, Tsukakoshi. M, 'Laser Microradiation of cells', Harward Academic publishers, New York, 1990.

Assessment Pattern

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

Assessment Questions

Remember

1. Define laser and list the components of laser system.
2. State Lambert's and Beer's law.
3. Define optical albedo.
4. Define absorption length.
5. Define ophthalmology.
6. List the laser treatment related to the retina of eye.
7. Define biosimulation.
8. Define MPE.
9. Define limiting aperture.
10. List the secondary laser hazards.

Understand

1. Classify the different types of interaction.
2. Explain the photo transport theory.
3. Explain the experimental methods to determine the reflection and absorption properties of laser.
4. Illustrate the steps in the LASIK technique.
5. Explain the use of optical tweezers.
6. Interpret the advantages of holography.
7. Explain the 3 grades of CIN.
8. Explain the role of laser in hemostasis.
9. Summarize the procedure of holographic endoscopy
10. What are the classes of laser?

Apply

1. The aortic wall has an absorption coefficient of 2.3cm-1 and the scattering coefficient of 310 cm-1 for He-Ne laser at a wavelength of 633nm.find the optical albedo of a tissue.
2. Demonstrate PDT.
3. Find out how much light is lost due to reflection, when a red laser beam accidentally exists a laboratory through an observation window, if the refractive index of the glass is 1.5 at visible wavelength.
4. Construct a system for the simultaneous measurement of different optical tissue properties.
5. Construct the energy level diagram of Nd-YAG laser.
6. Predict the flow chart for modeling thermal interaction.
7. Sketch the experimental setup for LIIT.
8. How sterilization is achieved using laser.
9. Draw the structure of tooth.
10. Mention the laser radiation hazards.

Analyse

1. Outline the conditions for the turbid media.
2. Differentiate the optical properties of normal and the diseased tissue.
3. Outline the different types of beam delivery system.
4. Compare photo physical process and photo biological process.
5. Compare the intensities of the scattered light in the Rayleigh scattering for 1W Nd-YAG laser at wavelength of 1064nm and a frequency doubled Nd-YAG laser at wavelength of 532nm.
6. If the curvature of the cornea in the initial and the final state is 7.8 mm and 7.965mm respectively. The refractive index of the cornea is 1.377. Resolve the degree of myopia.
7. A collinear, visible or near infrared laser beam is most dangerous to our vision, justify.

Evaluate

1. Determine the absorption length, if the absorption coefficient is 0.5

2. An ophthalmologist uses a 200 mW argon ion laser at a wavelength of 514nm to perform a retinal coagulation. The procedure takes 10 seconds. Determine is the optical density needed in his eyewear to protect his eye from accidental damage.
3. Determine the safety precautions to be followed for handling class 4 lasers.

Create

1. Derive the mean free optical path of the incident photons in the turbid media.
2. Relate the basic physical mechanism of plasma induced ablation and photo disruption and generate the laser parameter that has to be altered to switch from one type of interaction to the other?

15EC0YC TELEMEDICINE 3 0 0 3

Course Objectives

- Know Scope, Benefits, Limitations, security and standards in telemedicine.
- Understand basic parts of Teleradiology Systems.
- Study the need of Various Communication Networks, Antennas in Designing the Telemedicine 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.
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.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Apply improved patient engagement through technical assistance.
2. Provide long distance clinical healthcare, patient and professional health-related education.
3. Design electronic information and communication technologies for Telemedicine System.

4. Identify the Ethical and legal aspects of Telemedicine.
5. Apply the concepts in real time applications.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO TELEMEDICINE

History of Telemedicine, Block diagram of telemedicine system, Definition of telemedicine, Tele health, Tele care, origins and Development of Telemedicine, Scope, Benefits and limitations of Telemedicine.

UNIT II **9 Hours**

ROLE OF COMMUNICATION SYSTEMS IN TELEMEDICINE

Types of information: Audio, Video, still Images, text and data, Fax. Types of Communication and Network: PSTN, POTS, ATN, ISDN, Internet, Wireless Communications: GSM, satellite and Micro Wave. Different modulation techniques, Types of antennas depending on requirements, Integration and Operational issues: system integration, Store-and-forward operation, realtime Telemedicine.

UNIT III **9 Hours**

MULTIMEDIA IN TELEMEDICINE

Data Exchanges: Network Configuration, Circuit and packet switching, H.320 series (Video phone based ISBN) T.120, h.324 (Video phone based PSTN), Video Conferencing.

UNIT IV **9 Hours**

SECURITY ISSUES IN TELEMEDICINE

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, Phases of Encryption. Photocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7. Ethical and legal aspects of Telemedicine: Confidentiality and Law, patient rights and consent, access to medical Records, Consent treatment, jurisdictional Issues, Intellectual property rights.

UNIT V **9 Hours**

TELEMEDICINE SYSTEMS

Tele radiology: Basic parts of Teleradiology system: Image Acquisition system, Display system, Communication network, Interpretation. Tele Pathology: Multimedia databases, color images of sufficient resolution: Dynamic range, spatial resolution, compression methods, Interactive control of colour, Controlled sampling, security and confidentiality tools. Tele cardiology, Teleoncology, Telesurgery.

FOR FURTHER READING

Application of Telemedicine in healthcare delivery, Medical Data acquisition, Advanced telemedicine systems, Telemedicine Center Management Maintenance, Introduction to robotics and telesurgery.

Total: 45 Hours

Reference(s)

1. A.C.Norris, Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.
2. Olga Ferrer-Roca, M.Sosa Ludicissa, Handbook of Telemedicine, IOS press 2002.

Assessment Questions

Remember

1. Define the termsTelehealth and Telecare.
2. List any five applications of Telemedicine.
3. List the diiferent types of antennas used in transmission and reception of telemedicine system.
4. Write the importance of Tele-oncology in telemedicine
5. Explain in detail about the jurisdictional issues in telemedicine.
6. Enumerate the standards to be followed in DICOM.
7. List any five importance of video phone based PSTN system.
8. List any four applications of telemedicine related to rural health care.
9. List out the protocols used in telemedicine.

Understand

1. Explain in detail about the block diagram of telemedicine system.
2. Illustrate the telecommunication system components with neat diagrams.
3. Enumerate the secure data transmission and its standards for rural health care.
4. Discuss about the controlled sampling security.
5. Illustrate the establishment of telesurgery and also discuss its problems for space applications.
6. Discuss about the Image Display System in telemedicine.
7. Enumerate the key role of encryption and decryption in telemedicine.
8. Explain in detail about the Catriology and the key role in telemedicine.
9. With neat diagram, explain the importance of Video conferencing in telemedicine.
10. Discuss the importance of telemedicine malpractice.

Apply

1. Discuss the need for ethical and legal aspects of internet.
2. Differentiate between circuit and packet switching.
3. Discuss about the reason for having different data exchange formats in telemdicine.
4. Justify the need for integration and and spatial resolution in telemedicine.
5. Discuss about the application of Robotic system in Telesurgery.
6. Contrast the theoretical and practical aspects of Tele-oncology.
7. Examine the necessity for encryption mechanisms in telemedicine.
8. Telemedicine ensures confidentiality patient right.Justify
9. Discuss the importance of ANT network in Telemedicine.
10. Telemedicine ensures intellectual property rights. Justify
11. Discuss about the application ofTelesurgery system in Intravascular Neurosurgery.

Analyse

1. Discuss in detail the future applications for improving cancer care globally.
2. Discuss about the resolution of Video phone based ISBN.
3. Analyse the various phases of encryption in telemedicine.
4. Illustrate the advanvantages of telemedicine in military applications.
5. Analyse the resolution of colour images in telemedicine system.
6. Describe how satellite communication can help telemedicine.

Evaluate

1. Describe the importance of Image acquisition system in Teleradiology.
2. Enumerate the resolution of interactive control of colour.
3. Contrast the data transfer by spatial and dynamic range in telemedicine system.
4. Examine the Noval machine interface for scaled telesurgery.

Create

1. Establish Telesurgery through Robotic arm.
2. Establish Teleradiology using the GSM technology.

15EC0YD TRANSDUCERS AND INSTRUMENTATION 3 0 0 3

Course Objectives

- To provide students with a solid foundation in measurement systems, terminologies and error measurements.
- To impart knowledge in the concept of measuring devices.
- To train students so as to comprehend, analyze, design and create innovative products and solutions for the real life problems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Analyze the characteristics of measurement systems
2. Design displacement, temperature and thermo electric transducers
3. Design and analyze pressure measurement devices for real time applications
4. Design the transducers for velocity and Acceleration measurements
5. Analyze the transducer models for humidity, density and radiation measurements

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

UNIT I **9 Hours**

INTRODUCTION TO MEASUREMENT SYSTEMS

General concepts and terminology, measurement systems, sensor classification, static characteristics of measurement systems-accuracy, linearity, resolution, precision and sensitivity etc. Dynamic characteristics of measurement systems: Zero-order,first-order and second-order measurement systems.

UNIT II **9 Hours**

DISPLACEMENT MEASURING DEVICES

Displacement Resistive Potentiometer, inductive displacement transducer, Capacitive Displacement Transducers, Ultrasonic Methods, Temperature Thermal expansion methods, radiation methods: thermal and photon detectors based thermometers.

UNIT III **9 Hours**

PRESSURE MEASURING DEVICES

Dead weight gauges and manometers, elastic transducers, high pressure measurement. Velocity sensors obstruction meters, averaging Pitot tubes, Rota meters, Electromagnetic, Vortex shedding, Ultrasonic Flow meters.

UNIT IV **9 Hours**

VELOCITY AND ACCELERATION MEASUREMENT

Seismic displacement, velocity and acceleration pickups (Accelerometers). Gyroscopic angular displacement sensors, Force and Torque: Methods of force measurement and characteristics, Bonded strain gauge, Piezo Electric Transducer, Torque measuring on rotating shafts.

UNIT V **9 Hours**

HUMIDITY, DENSITY AND RADIATION MEASUREMENT

Capacitive Impedance and Piezoelectric Hygrometers. Differential Pressure, U-tube and ultrasonic Densitometers. pH measurement: Ion Selective Type. Radiation Fundamentals-Radiation Detectors-Radiation Thermometers. Optical Pyrometers

FOR FURTHER READING

Digital Sensors Position encodes, variable frequency sensors-quartz digital thermometer, SAW sensors, digital flow meters, sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, charge-coupled sensors

Total: 45 Hours

Reference(s)

1. Measurement Systems, E.O. Doeblin, Mc-Graw Hill Publication
2. Transducers and Instrumentation, D.V.S. Murthy, PHI Publication
3. Sensors & Transducers, D. Patranbis, Wheeler Publishing
4. Sensor Technology Handbook - Jon S. Wilson, Elsevier Publications
5. Instrument transducers, H.K.P Neubert, Oxford University Press.
6. Process Measurement and Analysis, B.G. Liptak, ISA Publication IVth edition

Assessment Questions

Remember

1. State the functional elements of an instrument.
2. Define accuracy of an instrument.
3. Define the terms precision and sensitivity.

4. Define transducers.
5. List the classification of transducers.
6. Write short notes on LVDT.
7. Define manometer.
8. Recognise vortex shedding for pressure measurement.
9. Define piezoelectric transducers.
10. Define densitometers.
11. Label optical pyrometer and its parts.

Understand

1. When static characteristics are important?
2. Distinguish reproducibility and repeatability.
3. Identify some static and dynamic characteristics.
4. Give the principle of capacitive transducer.
5. List out the features of piezoelectric transducers.
6. State the principle behind the anemometer.
7. List the advantages of ultrasonic flow meters in pressure measurement.
8. Exemplify the working of accelerometers.
9. List the methods for measuring force in instrumentation.
10. State the working principle of hygrometers.

Apply

1. Explain the Normal or Gaussian curve of errors in the study of random effects.
2. Discuss in detail the various static and dynamic characteristics of a measuring system.
3. Discuss in detail various types of errors associated in measurement and how these errors can be minimized.
4. Explain in detail the different methods of measuring displacement using passive devices.
5. Illustrate temperature thermal expansion and radiation methods in detail.
6. Explain in detail abouth the different pressure measuring instruments with suitable sketches.
7. Explain the working principle of velocity sensor in detail.
8. Demonstrate the methods of force masurement and its characteristics in detail.
9. Demonstrate the working principle of torque measurement on rotating shafts.
10. Explain the fundamentals of radiation,detectors and its thermometers in detail.

Analyse

1. Compare the static and dynamic characteristics of a measurement system.
2. Analyze the zero, first and second order measurement systems and their responses.
3. Compare resistive type and capacitive type displacement transducers with neat sketches.
4. Analyze the piezoelectric and ultrasonic transducers in detail.
5. Demonstrate the working of anemometer with suitable sketches.
6. Outline the working principle of velocity sensor obstruction meter in detail.
7. Justify, how the earth quakes can be predicted and explain the principle behind it.
8. Analyse the ion selective method for pH measurement in detail.

Evaluate

1. Calculate the geometric efficiency for a detector of diameter d = 7.5cm at a distance r = 20cm from a point source.
2. Calculate the pH of all chemical species that are present in the solution.

Create

1. Derive the relative humidity measurement using basic 8051 microcontroller.
2. Generate a mobile charger using the piezoelectric effect with neat circuits.

15EC0YE MEMS DESIGN 3 0 0 3

Course Objectives

- Exposure to the techniques useful in analytical design of structures, transducers, and process flows
- To have a knowledge about MEMS 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. PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

Course Outcomes (COs)

1. Identify the various processes involved in MEMS fabrication.
2. Analyze the various mechanics of materials for MEMS.
3. Design different MEMS structures using cantilever beams.
4. Classify the different types of transducers and its energy methods.
5. Analyze the equivalent circuits for dampers and gyroscopes.

Articulation Matrix

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

UNIT I **9 Hours**

MEMS FABRICATION PROCESS

Definitions for MEMS, MEMS roadmap, Benefits of Miniaturization, Example MEMS fabrication processes, Oxidation, Film Deposition Evaporation, Sputter deposition, Chemical vapor deposition (CVD), Plasma enhanced chemical vapor deposition (PECVD), Epitaxy, Atomic layer deposition (ALD), Electroplating, Lithography Etching Wet etching, Dry etching.

UNIT II **9 Hours**

MECHANICS OF MATERIALS FOR MEMS

Stress, strain, etc., for isotropic materials, Thin films: thermal stress, residual stress, and stress gradients, Internal dissipation, MEMS material properties and performance metrics.

UNIT III **9 Hours**

MEMS STRUCTURES

Bending of beams, Cantilever beam under small deflections, Combining cantilevers in series and parallel, Folded suspensions. Design implications of residual stress and stress gradients.

UNIT IV **9 Hours**

ENERGY METHODS

Energy Methods, Virtual Work, Energy Formulations, Energy Conserving Transducers, Parallel-Plate Capacitive Transducers, Charge Control, Voltage Control, Linearizing Capacitive Actuators, Electrical Stiffness, Electrostatic Comb-Drive .1st Order Analysis, 2nd Order Analysis.

UNIT V **9 Hours**

EQUIVALENT CIRCUITS

Lumped Mechanical Equivalent Circuits, dynamic mass, stiffness, and damping, example: free-free beam, lumped mass-spring-damper circuit, electromechanical analogies, lossless transducers, input modeling, force-to-velocity relationship & circuit, introduction to gyroscopes: output modeling, input-to-output transconductance, complete equivalent circuit.

Total: 45 Hours

Reference(s)

1. S. Senturia, Microsystem Design, 2nd Printing, Springer US Publisher, 2001.
2. G.Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill Science/Engineering/Math Publisher, 1stedition, 1998.
3. Jaeger, Introduction to Microelectronic Fabrication (Vol. V of the Modular Series on Solid State Devices), 2ndEdition, Pearson Publisher, 2001.
4. C. Liu, Foundations of MEMS, Pearson; 2ndedition, 2011.
5. N. Maluf, An Introduction to Microelectromechanical Systems Engineering, Artech House Print on Demand, First Printing edition, 2000.
6. J. Pelesko& D. Bernstein, Modeling MEMS and NEMS, CRC Press; 1stedition, 2002.

ONE CREDIT COURSES

15EC0XA SYSTEM ON CHIP DESIGN AND CDC TECHNIQUES **1 0 0 1**

Course Objectives

- To educate the students on VLSI Design Verification using latest trends followed in the industry.

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.

Course Outcomes (COs)

1. Apply the concepts of RTL and SV.
2. Identify the ASIC design concepts

Articulation Matrix

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

UNIT I **3 Hours**

RTL DESIGN CONCEPTS

Introduction to SoC Design, ASIC Design flow, Front-End design flow, Back-end design flow, Multi clock SoC design concepts, Synthesis concepts, Verilog coding for Synthesis.

UNIT II **6 Hours**

SV CONCEPTS

Introduction to Verification using HVLs, Difference between Verification and Testing, Introduction to SV, Data Types, SV Stratified Event Queue/Scheduler, SV Tasks and Functions, Verification Specific SV Constructs, Functional Coverage, Verification Plan and SV Testbench Architecture.

UNIT III **6 Hours**

ASIC DESIGN CONCEPTS

Concepts of STA, Clocks & Virtual Clocks, Operating Conditions, Analysis of various Modes & Corners, Analyzing the Timing Reports, Signal Integrity, Clock Domain crossing (CDC) techniques, SoC Timing verification, Power analysis, Standard Delay Format.

Total: 15 Hours

Reference(s)

1. Prakash Rashinkar, Peter Paterson, LeenaSingh , System-on-a-chip Verification Methodology and Techniques, Kluwer Academic Publishers, 2002.

15EC0XB PROGRAMMABLE LOGIC CONTROLLERS (PLC) PROGRAMMING **1 0 0 1**

Course Objectives

- Able to understand the addressing and control of PLC and to perform PLC programming.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. To identify the need of PLC
2. To implement the real time automations based on PLC.

Articulation Matrix

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

UNIT I **3 Hours**

INTRODUCTION AND NEED OF PLC

Architecture of PLC - different modules, power supply unit - Need of PLC in designing - Different types of sensors - sinking, sourcing, NPN, PNP - Monitoring the process through sensors - connection details.

UNIT II **2 Hours**

ADDRESSING AND CONTROL

Analog addressing, continuous process monitoring and control - Different types of controllers -ON/OFF, Proportional, Derivative, Integral and PIDcontrol.

UNIT III **10 Hours**

PLC PROGRAMMING

PLC Programming of branded PLCs - NO/NC concept - Data file handling - forcing I/O - Wiring and fault correction - Programming practices.

Total: 15 Hours

Reference(s)

1. Reference manual should be provided by the industry.

15EC0XC SDR - SOFTWARE DEFINED RADIO 1 0 0 1

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Course Objectives

- To make the students to get knowledge of fundamental and state-of-the-art concepts in software-defined radio.

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

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

Course Outcomes (COs)

1. Identify the SDR challenges
2. Able to describe the implementation targets

Articulation Matrix

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

UNIT I **3 Hours**

INTRODUCTION

Introduction to Software Defined Radio, Radio technology evolution - Basics of Radio section - Digital Signal Processing and Digital Communication functional modules.

UNIT II **6 Hours**

SDR CHALLENGES

Physical Layer functions- Digital generation of signals -Application of signal processing- ADC/DAC choices and issues - RF system functional blocks and implementation issues.

UNIT III **6 Hours**

IMPLEMENTATION TARGETS

SDR architecture - Implementation Targets- GPP/FPGA/SoC/ASIC - Typical implementations - Performance analysis - Commercially available platforms.

Total: 15 Hours

Reference(s)

1. J.H. Reed, Software-Defined Radio, Prentice - Hall, 2002

15EC0XD EMBEDDED SYSTEMS WITH C AND GNU DEVELOPMENT TOOLS

1 0 0 1

Course Objectives

- To educate the students on Embedded System Design using ARM Cortex-MF4 and the latest trends followed in the industry.

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Able to identify the engineering system design concepts
2. Able to perform embedded peripherals programming

Articulation Matrix

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

UNIT I **3 Hours**

EMBEDDED SYSTEM DESIGN CONCEPTS

Introduction to Embedded system Design, Getting to Know the Hardware, Your First Embedded Program, Compiling, Linking, and Locating, Downloading and Debugging, ARM Cortex-MF4 Hardware connection, Hex File and Flash Loaders.

UNIT II **6 Hours**

EMBEDDED PERIPHERALS PROGRAMMING-1

ARM Cortex-M4F GPIO Programming, ARM Cortex-M4F Timer Programming, Interrupt programming, Serial Port Programming, LCD and Keyboard interfacing.

UNIT III **6 Hours**

EMBEDDED PERIPHERALS PROGRAMMING-II

ADC,DAC and Sensor interfacing, Input Capture and wave generation in ARM Cortex-M4F,PWM Programming and DC Motor Control in MF4,SPI & I2C Protocol-Interfacing zig-bee,Bluetooth,Wifi.

Total: 15 Hours

Reference(s)

1. Michael Barr and Anthony Massa, Programming Embedded Systems with C and GNU Development Tools, 2nd Edition,O'Reilly Media, 2006.

15EC0XE ADVANCED VERIFICATION METHODOLOGIES **1 0 0 1**

Course Objectives

- To learn the advanced verification languages & methodologies and to understand the new features of System Verilog for verification and demonstrate the improvements in verification platform.

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.

Course Outcomes (COs)

1. Able to identify the various verification methodologies
2. Able to apply the verification methods using VERILOG and UVM

Articulation Matrix

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

UNIT I **3 Hours**

IDEAS IN VERIFICATION

ASIC Design, Verification Plan, Phases of Verification, Testbench Example.

UNIT II **8 Hours**

ADVANCED VERIFICATION USING SYSTEM VERILOG

Overview of HDL and HVL, Need for System Verilog, Data types, Casting, Understanding the procedural statements and control flow, process execution threads, Interface and Modports, Virtural Interfaces, Clocking blocks, Module, Program, Classes and Randomization and constraints, Riding SV on Chariot of OOPs, Coverage based Verification.

UNIT III **4 Hours**

ADVANCED VERIFICATION USING UVM

Verification Methodology - UVM Basics, UVM Components- Agents, Sequencer, Sequence. Macros, TLM, UVM Phasing, UVM Factory and Advanced sequence control, Register Modeling using UVM Register Layer, Reporting, UVCs.

Total: 15 Hours

Reference(s)

1. SystemVerilog for Verification: A Guide to learning the Testbench Language Features, Author: Chris Spear, ISBN: 0387270361.
2. Hardware Verification with System Verilog, Author: Mintz, Mike, Ekendahi, Robert, ISBN: 978-0-387-71738-8.
3. Writing Testbenches using SystemVerilog, Author: Bergeron, Janick, ISBN: 978-0-387-29221-2
4. SystemVerilog for Design and Verification using UVM, Author: Azadpour, Mark A. ISBN: 978-1-4614-1758-3

15EC0XF AUTOMOTIVE - TRANSMISSION ELECTRONICS **1 0 0 1**

Course Objectives

- To learn Automotive mechanical, transmission and braking systems and to update the latest trends followed in the industry.

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. 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. Able to identify the functionality of automotive mechanical system
2. Able to demonstrate the working of braking and Engine Control Unit

Articulation Matrix

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

UNIT I **3 Hours**

AUTOMOTIVE MECHANICAL SYSTEM

Vehicle systems, Power Train System(Air system, Fuel system(Carburetor& Diesel Fuel Injection, Ignition system, Exhaust system and other Auxiliary Systems(Cooling, Lubrications & Electrical Systems))

UNIT II **6 Hours**

TRANSMISSION AND BRAKING SYSTEM

Transmission System (Front, Rear & 4 Wheel Drive, Manual, Automatic Transmission, Differential), Braking system (Drum, Disc, Hydraulic, Pneumatic), Steering System(Rack and Pinion, Power Steering)

UNIT III **6 Hours**

ENGINE CONTROL UNIT

Performance (Speed, Power, and Torque), Control (Emission, Fuel Economy, Drivability and Safety) & Legislation (Environmental legislation for pollution and safety Norms).Overview of vehicle and ECU.

Total: 15 Hours

Reference(s)

1. Automotive handbook by Bosch.

15EC0XG EMBEDDED SYSTEMS DESIGN USING MSP430 1 0 0 1

Course Objectives

- To acquire the knowledge of embedded system design using MSP430 microcontrollers.

Programme Outcomes (POs)

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

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

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 identify the fundamental need of Low power embedded system
2. To design low power embedded systems.

Articulation Matrix

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

UNIT I **10 Hours**

INTRODUCTION TO MSP430

Motivation for MSP430 microcontrollers- Low Power embedded systems, On-chip peripherals (analog and digital), low-power RF capabilities. Target applications (Single-chip, low cost, low power, high performance system design).MSP430 RISC CPU architecture, Compiler-friendly features, Instruction set, Clock system, Memory subsystem. Key differentiating factors between different MSP430 families. Introduction to Code Composer Studio (CCS v4). Understanding how to use CCS for Assembly, C, Assembly +C projects for MSP430 microcontrollers-Interrupt programming-Digital I/O -I/O ports programming using C and assembly, Understanding the muxing scheme of the MSP430 pins.

UNIT II **10 Hours**

PERIPHERAL INTERFACES

On-chip peripherals. Watchdog Timer, Comparator, Op-Amp, Basic Timer, Real Time Clock (RTC),ADC, DAC, SD16, LCD, DMA-Using the Low-power features of MSP430. Clock system, lowpowermode s, Clock request feature, Low-power programming and Interrupt-Interfacing LED, LCD, External memory. Seven segment LED modules interfacing. Example-Real-time clock. Case Studies of applications of MSP430 - Data acquisition system, Wired Sensor network, Wireless sensor network with Chipcon RF interfaces.

Total: 20 Hours

Reference(s)

1. Chris Nagy, Embedded Systems Design Using the TI MSP430 Series, Newnes publisher, 2003.

15EC0XH LTE TECHNOLOGY 1 0 0 1

Course Objectives

- To acquire knowledge on fundamental technologies involved in LTE.

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.

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. Identify the need of LTE FDD & LTE TDD techniques.
2. Demonstrate the working functionality of network elements of LTE network structure.
3. Able to describe basic call processes, channels and MIMO antenna techniques involved in LTE.

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														

UNIT I **3 Hours**

LTE- A NEW ERA

Evolution from 2G to 4G LTE (FDD/TDD)-Why LTE? - LTE Releases -LTE Network architecture.

UNIT II **6 Hours**

LTE TECHNOLOGY AND AIR INTERFACE

LTE Bandwidth, Spectrum -LTE Frame Structure (TDD & FDD), Cyclic prefix - OFDMA , SC - FDMA introduction - LTE Channels - LTE Physical , MAC, RLC, PDCP & RRC Layers and their functionalities - Paging procedure - Call flows in LTE - Power Control - Hand over - Multiple antenna techniques(MIMO) -CSFB -SRVCC.

UNIT III **6 Hours**

LTE-4G

Introduction to LTE -Network Architecture -E-UTRAN and EPC Roles of UE,ENB,MME - S-GW,P-GW and HSS - Interfaces:S1,X2,S6a,S5 and S11 - LTE air interface OFDM, MIMO, Antenna considerations - CS-Fall back, Volte and SR-VCC -Interworking with 2G/3G wireless Networks, Mobility in LTE - WLAN standards, WLAN concepts, WLAN architecture, WiMax

Total: 15 Hours

Reference(s)

1. Christopher Cox, An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications, second edition, Wiley publishers, 2012.

15EC0XI EMBEDDED SYSTEMS DESIGN USING ARDUINO HARDWARE AND IDE

1 0 0 1

Course Objectives

- To educate the students on Embedded System Design using Open Source Hardware Arduino with IDE and the latest trends followed in the industry.

Programme Outcomes (POs)

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.

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

Course Outcomes (COs)

1. Identify the engineering system design concepts
2. Perform embedded peripherals programming

Articulation Matrix

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

UNIT I **3 Hours**

EMBEDDED SYSTEM DESIGN - BASIC INTERFACING WITH ARDUINO

Introduction to Arduino, LED,SWITCH Interfacing ,Serial Communication, PWM with LED ,Display Interfacing - Liquid Crystal Display, OLED, Seven Segment Display, Motor Interfacing- DC Motor, Stepper Motor, Servo Motor.

UNIT II **6 Hours**

INTERFACING ANALOG AND DIGITAL SENSORS WITH ARDUINO

Sensors Interfacing -PIR Sensor, Moisture Sensor, Ultrasonic Sensor, Gas Sensor, IR, Analog Sensor interfacing- Temperature sensor(LM35),Accelerometer Sensor, LDR, ADC, Flex Sensor.

UNIT III **6 Hours**

INTERFACING COMMUNICATION DEVICES

Communication Devices Interfacing - Bluetooth, WiFi Module(ESP8266),NODE MCU ESP8266, RFID, ZIGBEE, GPS,GSM/GPRS, TSOP TV Remote control, Applications of IoT - Device Control, Data Monitoring System.

Total: 15 Hours

Reference(s)

1. Reference manual should be provided by the industry.

15EC0XJ REAL TIME DATA ACQUISITION AND SIGNAL PROCESSING USING LABVIEW — 1 0 0 1

Course Objectives

- To educate the students on real time data acquisition and signal processing using LABVIEW.

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.
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.

Course Outcomes (COs)

1. Identify the programming concepts in LABVIEW.
2. Perform data acquisition and control using LABVIEW.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO LABVIEW

Introduction to virtual Instrumentation, Introduction to Graphical Programming, Programming Architecture in LabVIEW, Building Virtual Instruments, Various Tool Boxes.

UNIT II **7 Hours**

DATA ACQUISITION AND CONTROL

Introduction to Data Acquisition and control, Prototyping using NI ELVIS, Using NI MyDAC.

Total: 15 Hours

Reference(s)

1. Reference manual will be provided by the industry.

15EC0XK EMBEDDED SYSTEM DESIGN USING ARM CORTEXM4 — 1 0 0 1

Course Objectives

- To educate the students on embedded system design using ARM CORTEXM4.

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Identify the working of microcontroller and its modules.
2. Interface different sensors and displays.

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

INTRODUCTION TO MICROCONTROLLERS

Introduction to Microcontrollers, Architecture of TIVAC123GH6PM, Introduction to Code Composer Studio, Working with GPIOs, Interfacing LCD Display, Working with Timer Module Generating Delays, Working with ADC, Interfacing Temperature, Humidity and PIR Sensors, Working with SPI Module and Interfacing Matrix LED Display.

Total: 15 Hours

Reference(s)

1. Reference manual will be provided by the industry.

15EC0XL MICROWAVE/RF CIRCUIT DESIGN INCLUDING 3D EM MODELING

1 0 0 1

Course Objectives

- To acquire knowledge for designing microwave and RF circuits including 3D EM modeling.

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Design antenna and filter using simulation tool.
2. Analysis and optimization of antenna design.

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									

UNIT I **15 Hours**

ANTENNA DESIGN

Antenna and Filter design- S Parameters, Far field Analysis, 3D simulation of antenna, Passive Components, MOM, FEM, FDTD, AC, DC, harmonic balance analysis, optimization, tuning of a design.

Total: 15 Hours

Reference(s)

1. Reference manual will be provided by the industry.

15EC0XM APPLICATIONS OF ANN AND FUZZY LOGIC

1 0 0 1

Course Objectives

- To educate the students on Soft Computing tools using Open Source SCILAB followed in the industry for various Artificial Intelligence based product development.

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.

Course Outcomes (COs)

1. Identify Artificial Intelligence based problems
2. Provide solutions to Expert System problems

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 **3 Hours**

INTRODUCTION TO ANN

Need of Soft Computing Models, Basic principle behind ANN and Fuzzy Logic, Mcculloch-Pits Neuron Model, Comparing Biological Brain and ANN model.

UNIT II **6 Hours**

ANN LEARNING ALGORITHMS

Supervised and Unsupervised models, Perceptron learning model, Delta learning model, Back Propagation Network (BPN) model and Self Organizing Map. Implementation of ANN algorithms for Pattern Recognition Problem ranging from Biometrics to Character Recognition task.

UNIT III **6 Hours**

FUZZY LOGIC MODELS

Introduction to Mamdani and Sugeno Fuzzy Inference Models, Building a Fuzzy Based Expert System Model, Implementation of Fuzzy Models in SCILAB for applications ranging from Fuzzy based Consumer Electronics to Medical Expert System.

Total: 15 Hours

Reference(s)

1. Introduction to Artificial Neural Systems, Jacek M.Zurada (WPC, 1992)
2. Fuzzy Logic with Engineering Applications, Timothy J.Ross (Wiley)

15EC0XN TEST ENGINEERING 1 0 0 1

Course Objectives

- To understand the role of an Test Engineer in Manufacturing Industry
- To acquire an awareness on Testing Methodologies

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.

Course Outcomes (COs)

1. Identify the role of a Test Engineer in Manufacturing Industry
2. Acquire an awareness on Testing Methodologies

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 **15 Hours**

TESTING

Introduction to test engineering - Need and Importance of Test Engineering - Fundamental Testing Methods - PCB Track Short Testing Methods - Concepts of trouble Shooting PCBs - Manual and Automated PCB troubleshooting Techniques - Automated Test Techniques - Functional Test Methods - Combinational testing techniques - V-I(Signature) Testing Methods And Technology- In Circuit Test - Boundry Scan Test - Memory Testing Techniques - Electrical Endurance Test - Good Versus Suspect interpretation Comparison - Basic of Digital Simulator.

Total: 15 Hours

Reference(s)

1. Practical Electronic Fault Finding and Trouble shooting by Robin Pain Newnes, Reed Educational and professional publishing Ltd., 1996
2. The Fundamentals of Digital Semiconductor Testing, Floyd, Pearson Education India, Sep-2005.

15EC0XO EMBEDDED PROTOCOLS 1 0 0 1

Course Objectives

- To understand the concepts of different embedded communication bus protocols.

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.

Course Outcomes (COs)
1. Interfacing and programming of I2C and SPI protocols for embedded applications.
2. Interfacing and programming of CAN and ZigBee protocols for embedded 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	2										

UNIT I **15 Hours**

COMMUNICATION PROTOCOLS
Serial & Parallel Communication, I2C Bus characteristics, Data Transfer, Interfacing & Programming I2C based EEPROM, Introduction to SPI protocol, Interfacing SPI based Graphic LCD Display Interface, Interfacing SPI based Touch Screen with Controller. Introduction to Serial Communication using UART, The Physical Layer Standards, Programming UART in MCU to Communicate with PC, UART based Password Authentication System, Introduction to CAN, CAN Frame Formats, CAN Frame Formats, Establishing CAN Communication network between two controllers, Introduction to Bluetooth, AT Commands for Bluetooth Communication, Introduction to ZigBee Protocol, Understanding the X-CTU Terminal & Configurations of ZigBee Nodes, ZigBee Based Home Automation.

Total: 15 Hours

Reference(s)
1. Reference manual will be provided by the industry.

15EC0XP INTERNET OF THINGS 1 0 0 1

Course Objectives
- To understand the architecture and working of IoT and its application.
- To study the concepts of architectural support for IoT.
- To study system concepts for IoT application development.

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.

Course Outcomes (COs)

1. Identify different functional blocks in an IoT System and their Applications.
2. Analyse and Compare various IoT 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	2										

UNIT I **5 Hours**

INTRODUCTION TO IOT PROTOCOLS

IoT definition, need & importance, ecosystem & its elements, IoT in sports, IoT in Cities/transportation, IoT in the home, IoT in retail, IoT in healthcare, IoT standards. Protocols: MQTT, CoAP, AMQP, Websocket, Node, NFC & RFID, ZigBee, MIPI & M-PHY, UniPro & SPMI, SPI& M-PCIe, 6LoWPAN, Thread, Wi-Fi, NFC, Sigfox, Neul, LoRaWAN.

UNIT II **5 Hours**

TELECOM

Connectivity and networks, IoT requirements on wireless networks, Wireless technologies for the IoT :2G,3G, 4G & Advanced, Overview to SDN-NFV, Cloud computing, edge computing, RooF, Data analytics Overview, Signal Processing, IoT- Cloud Connectivity, Fog Computing & IoT Security.

UNIT III **5 Hours**

RASPBERRY PI , PYTHON AND OOPS

Python development environment setup, Different python development tools, Variables and different data types, Conditional and looping constructs Python functions and modules, Variable Scope Ã¢?? Global, local & Non-Local, Interface LED`s with Raspberry Pi using Python, Interface Motion detection sensor to Raspberry Pi, OOPS Concepts - Classes and objects, setting up MQTT protocol development environment, Publish and subscribe architecture, Quality of Service, MQTT offline mode, Topics Ã¢?? single level Vs Multi level topics, Interface MPC3008 SPI based ADC, Push ADC data to the cloud.

Total: 15 Hours

Reference(s)

1. Reference manual will be provided by the industry.

15EC0XQ REAL TIME OPERATING SYSTEM 1 0 0 1

Course Objectives

- To understand the concepts of real time operating system.

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.

Course Outcomes (COs)

1. Recognize different functions of Real Time Operating System.
2. Describes the design issues and queue management in RTOS.

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 **15 Hours**

REAL TIME OPERATING SYSTEMS

Introduction to Operating system, Difference between GPOS and Embedded OS, Real-Time System, Types of Real-Time System, Real-Time Operating System, Task & Task Management,Task Synchronization,Scheduler, Inter-Task Communication, Common design issues,Interrupts, Queue Management.

Total: 15 Hours

Reference(s)

1. Instructor Reference Material.
2. Raspberry Pi Cookbook, Software and Hardware Problems and Solutions, by Simon Monk (O REILLY Publications).
3. Getting Started with Raspberry Pi, by Matt Richardson & Shawn Wallace.
4. Digitizing the industry IOT connecting the physical, Digital & Virtual Worlds by River Publishers Series in Communications: Editors: Ovidiu Vermisan & Peter Friess.

15EC0XR M2M FOR SMART CITIES 1 0 0 1

Course Objectives

- To gain fundamental requirements and challenges of machine-to-machine (M2M) communication, Internet of Things and how to integrate such technology into existing infrastructure for Smart City 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.

Course Outcomes (COs)

1. Identify how science and technology have developed to enable the M2M.
2. Classify the standards for Various M2M applications
3. Design and Test M2M/ IOT Products
4. Analyze the role of M2M in Smart Cities

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	1	2	3											
4	2	2	3	3										

UNIT I **3 Hours**

M2M STANDARDS AND ARCHITECTURE

M2M-Smart City- Definition and Requirements - M2M standards - Challenges and issues - ETSI-Security -M2M Applications

UNIT II **3 Hours**

WIRELESS TECHNOLOGIES FOR M2M

Machine Type Devices(MTD)-Control Units - Sensors and Actuators-Machine type Communication (MTC) - Frequency Spectrum-Licensed and Unlicensed-BLE - Zwave - Wifi - WiSUN-FAN-LoRa-Sigfox-Dash7-Ingenu- Ant-6LoWPAN-M2M and LoRa Gateways.

UNIT III **4 Hours**

LORA FOR M2M

LoRa- Specifications- LoRa Modules-Types- LoRa Modulation- RF- Power- Bandwidth-Channel Allocations-Spreading - Transceivers- Point to Point Communication.

UNIT IV **4 Hours**

SMART CITIES

What is Smart City?- Smart City Features- Strategy- Challenges- City Profiles of 20 Smart Cities - City Challenges and Smart Solution

UNIT V **4 Hours**

CASE STUDIES

Smart City Design Thinking-Planning -Use case driven Approach-Road Map to Smart City and Smart Villages -Case Studies.

Total: 18 Hours

Reference(s)

1. M2M Communications, A systematic Approach David Boswarthick, Omar Elloumi, Olivier_Hersent, Wiley 2012
2. Building the Internet of Things With IPv6 and MIPv6 , The Evolving World of M2M Communications ,Daniel Minoli, Wiley 2013

3. Building Smart Cities Analytics, ICT, and Design Thinking Carol L.Stimmel, CRC Press T&F, 2016
4. Smart Cities: The Internet of Things, People and Systems, Dustdar, Schahram, Nastić, Stefan, Šćekić, Ognjen, Springer 2017

ADDITIONAL ONE CREDIT COURSES (I to III Semesters)

15GE0XA HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts.
2. Understand the fundamental concepts of yogic practice and physical fitness.
3. To acquire the knowledge about nutrition and health consciousness.

Fitness: Meaning & Definition – Need & importance of Physical fitness – Types Physical fitness - Exercise, Training and Conditioning and it is important.

Yoga: Meaning and definition – Principles of practicing – Basic Asana and it important – Pranayama and Meditation - Relaxation Techniques.

Nutrition and Balance Diet: Needs and Important – Significant of Nutritional Food - Tips for balance diet. **Common Diseases for IT professionals:** Common diseases - cause – prevention – First aid for common sports injuries.

Total: 15 Hours

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.

15GE0XB FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY 1 0 0 1

Course Objective

The course focuses on community radio technology and various program productions techniques for radio broadcasting.

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording
2. Examine the available options for telephony interfaces for radio
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

INTRODUCTION TO COMMUNITY RADIO

Evolution of Community Radio (CR) in India- principles behind setting up of CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

STUDIO TECHNOLOGY

Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production- telephony interfaces for radio- audio Post Production

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, “Other Voices: The Struggle for Community Radio in India”, SAGE Publications India,2007.

3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Seán Ó Siochrú, "Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation", University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.procosound.com

15GE0XC VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills.

Course outcome (COs)

1. Solve problems creatively in mathematics and its applications.

Vedic Mathematics

Addition- Subtraction- System of Multiplication**-** Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

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.

15GE0XD INTRODUCTION TO ALGORITHM 1 0 0 1

Course Objectives

- Analyze the asymptotic performance of algorithms, Divide and conquer and Dynamic Problems.
- Use Sorting and Searching algorithms for arranging the data.
- Apply important algorithmic techniques to solve the real world Problems.

Course Outcomes (COs)

1. Apply Divide and conquer and Dynamic Programming Algorithm techniques to Provide the solutions for simple Problems.
2. Design algorithms for Performing Sorting and Searching of data.
3. Construct the Graph, Heap and BST for the given Data information.

Algorithm Design Techniques: Divide and Conquer, Dynamic Programming, Sorting and Searching, Basic graph algorithms –Simple Data Structures: Heaps, Balanced Search Trees.

Total: 15 Hours

Reference(s)

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015.
2. Thomas H. Cormen. Charles E. Leiserson. Ronald L. Rivest. Clifford Stein, Introduction to Algorithms, Second Edition, MIT Press, 2014.
3. J.P.Tremblay and P.G.Sorenson, An Introduction to Data Structures with Application II Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

15GE0XE ETYMOLOGY 1 0 0 1

Course Objectives:
- To enhance the level of vocabulary by understanding the origin / root of English words
- To stimulate an appreciation for the English language
- To promote effective oral and written communication through improved vocabulary

Course Outcome (COs):
- Identify prefixes, roots, and suffixes of words from Latin, Greek, Germanic, and Anglo - Saxon
- 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

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 - 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

References:

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

15GE0XF HINDUSTANI MUSIC 1 0 0 1

Course Objectives:
- To provide an understanding on aesthetic and therapeutic aspects of Hindustani music
- To identify and differentiate the various styles and nuances of Hindustani music

Course Outcomes (COs):
Students will be able to:
- Understand the aesthetic and therapeutic value of Hindustani Music
- To appreciate the Hindustani musical compositions

Introduction to music - Aesthetics of Hindustani Music - Classification (Raga, instruments, style as per the presentation and the gharaanaas) - Folk music, Dhamaar, Dhrupad, Taal and Raga - Bandeesh, Taraanaa - Madhya and drut laya, Vilambit khyaal as demonstration - Therapeutic benefits of Hindustani music

Total: 15 hours

References:
1. Devdhar B.R., Raga bodh (Part 1 & 2), Devdhar School of Indian Music, Mumbai, 2012.
2. Vasant, Sangeet Vishaarad, Hathras, Uttar Pradesh, 2015.

Websites:
1. *raag-hindustani.com/*
2. *play.raaga.com/Hindustani*
3. *raag-hindustani.com/Scales3.html*
4. www.poshmaal.com/ragas.html
5. www.soundofindia.com/raagas.asp
6. https://www.quora.com/Which-is-the-toughest-raga-in-Indian-classical-music
7. *www.likhati.com/2010/10/20/popular-ragas-for-the-beginner-ear-durga*

15GE0XG CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives
- To understand the importance of safe methods of treating solid wastes generated through various human activities.
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues.

Course Outcomes (COs)
1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious.

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

15GE0XH AGRICULTURE FOR ENGINEERS 1 0 0 1

Course Objectives

1. To impart the basic knowledge of agricultural and horticultural crops, cropping systems.
2. To study the weed and nutrient management, irrigation water requirement and its quality.

Course Outcomes (COs)

1. Understand the science of Agriculture.
2. Summarize and apply the methodologies needed in agriculture based on the field conditions.
3. Develop enough confidence to identify the crop patterns in real world and offer appropriate solutions.

Agronomical practices and Crops 5 Hours

Definition and scope of agronomy , Classification of Crops, agricultural and horticultural crops Effect of Different Weather Parameters on Crop Growth and Development , Principal of Tillage, Tilth and Its Characteristics, Role of Water in Plant and Its Absorption, Conduction and Transpiration of Water and Plant Processes, Soil Water Extraction Pattern and Plant Response. Introduction to weeds, Weeds Control.

Crop rotation, cropping systems, relay and mixed cropping **5 Hours**

Crop Rotation, Different Cropping Systems – I, Different Cropping Systems – II, Scope of Horticultural Crops, Soil Requirement for Fruits, Vegetables and Flowers Crops, Climatic Requirement for Fruits, Vegetables and Flowers Crops.

Plant nutrients **5 Hours**

Essential Plant Nutrients, Nutrient Deficiency, Toxicity and Control Measures. Chemical fertilizers, fertilizer Reaction in Soil and Use Efficiency

Quality of irrigation water and irrigation methods **5 Hours**

Quality of Irrigation Water, Poor Quality of Irrigation Water and Management Practices. Surface Irrigation methods, and micro irrigation methods

Total: 20 hours

Reference(s)

1. SP. Palaniappan, and S. Sivaraman, Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.
2. S.Sankaran and V.T Subbaiah Mudaliar, Principles of Agronomy, the Bangalore Printing and Pubg Co, Bangalore, 1993.
3. P.Balasubramain and SP. Palniappan, Principles and Practices of Agronomy, Agrobios publishers, Ludhiana, 2001.
4. T.Yellamanda Reddy and G.H. Sankara Reddi, Principles of Agronomy, Kalyani publishers, Ludhiana, 2005
5. B.Chandrasekaran, B. , K. Annadurai and E. Somasundaram, A Text book of Agronomy, Scientific publishers, Jodhpur, 2007
6. George Acquaah, Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd., New Delhi, 2002.

15GE0XI INTRODUCTION TO DATA ANALYSIS USING SOFTWARE 1 0 0 1

Course Objectives

- To familiarize students on the features of MS Excel.
- To enable the students to use Excel in the area of critical evaluation.
- Facilitate the student to construct graphs.

Course Outcomes (COs)

1. Create versatile Excel document.
2. Apply built in functions for data analysis.
3. Prepare dynamic Charts.

Excel Fundamentals and Editing **4 Hours**

Starting and Navigating a Worksheet– Entering Information – Hyperlinks – Saving – Editing Techniques – Entering a Series of Labels, Numbers and Dates – Checking Errors.

Formatting **4 Hours**

Formatting Cells – Changing Column Widths and Row Heights – Creating Conditional Formatting – Using Styles – Creating and Modifying Templates – Changing Page Breaks.

Power Organizing and Customizing Excel **4 Hours**

Managing Worksheets – Referencing Cells in Other Worksheets – Using More than One Work Book – Managing Shared Work Books – Protecting Worksheets and Workbooks.

Adjusting Views – Setting Printing Options – Using Multiple Panes – Customizing Excel Using the Options Dialog Box.

Crunching Numbers **5 Hours**

Building a Formula – Using Basic Built-in Functions – Using Functions to Analyze Data – Using Names in Functions – Array Functions

Work Sheet Charts **3 Hours**

Planning a Chart – Creating Chart – Formatting a Chart – Adding Labels and Arrows.

Total: 20 Hours

Reference(s)

1. Michael J. Young, Michael Halvorson, “Office System 2007 Edition”, Prentice-Hall of India (P) Ltd., New Delhi, 2007
2. John Walkenbach, “Microsoft Office Excel 2007”, Wiley Publishing, Inc. 2007
3. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007
4. Mark Dodgeand Craig Stinson, “Microsoft Office Excel 2007 Inside Out”, Microsoft Press, 2007

15GE0XJ ANALYSIS USING PIVOT TABLE **1 0 0 1**

Course Objectives

- To familiarize students on the features of Pivot Table.
- To enable the students to use Pivot Table in the area of data analysis.
- Facilitate the student to construct the charts for visualization of data.

Course Outcomes (COs)

1. Able to construct the Pivot Table and Group, Sort, Filter the Data to do the analysis.
2. Able to do the Calculation with in Pivot Table for advance analysis.
3. Capable of Constructing Pivot Charts to make visual presentation.

Pivot Table Fundamentals **4 Hours**

Introduction about Pivot Table, Why and When to use the Pivot Table, Anatomy of the Pivot Table, Limitations, Preparing the Source Data, Creating the Pivot Table.

Grouping Pivot Table Data **4 Hours**

Grouping the Items in a Report Filter, Grouping Text Items, Grouping Dates by Month, Grouping Dates Using the Starting Date, Grouping Dates by Fiscal Quarter, Grouping Dates by Week, Grouping Dates by Months and Weeks, Grouping Dates in One Pivot Table Affects Another Pivot Table, Grouping Dates Outside the Range.

Sorting and Filtering Pivot Table Data **4 Hours**

Sorting a Pivot Field: Sorting Value Items, Sorting Text Items, Sorting Items in a Custom Order. Filtering a Pivot Field: Manual Filter, Label Filter, Value Filter, Multiple Filters.

Calculations within the Pivot Tables **5 Hours**

Using Formulae: Creating a Calculated Field with and without "IF Condition, Calculated Item, Using Custom Calculations: % of Column, % of Row, % of Total, % Of, Running Total, Difference From, % Difference From, Index.

Pivot Charts **3 Hours**

Creating a Normal Chart from Pivot Table Data, Filtering the Pivot Chart, Changing the Series Order, Changing Pivot Chart Layout Affects Pivot Table, Changing Number Format in Pivot Table Affects Pivot Chart, Converting a Pivot Chart to a Static Chart, Refreshing the Pivot Chart, Creating Multiple Series for Years

Total: 20 Hours

Reference(s)

1. Debra Dalgleish, "Excel 2007 - PivotTables Recipes A Problem-Solution Approach", Apress, 2007, (ISBN-13 (pbk): 978-1-59059-920-4)
2. Bill Felen and Michael Alexander, "Pivot Table Data Crunching for Microsoft Office 2007", Pearson Education, Inc., QUE Series.
3. Wayne L. Winston, "Microsoft Office Excel 2007: Data Analysis and Business Modeling", Microsoft Press, 2007
4. John Walkenbach, "Microsoft Office Excel 2007", Wiley Publishing, Inc. 2007

5. Mark Dodgeand Craig Stinson, "Microsoft Office Excel 2007 Inside Out", Microsoft Press, 2007
6. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007

15GE0XL INTERVIEW SKILLS

1 0 0 1

Course Objectives
- To develop an understanding of interview dynamics and techniques, and its importance in career enhancement
- To train students to face interviews

Course Outcomes (COs)
Students will be able to:
- Demonstrate appropriate interview skills and attend all types of interviews
- Participate in group discussions with confidence

Interview preparation - Overcoming interview nerves - Types of Interview - Handling questions - Group Discussion - Dynamics of group discussion - Presentation skills - E-mail etiquette - Body Language

Total: 15 hours

References:
1. Gray Jack, Interviewing: Interview Questions - Job Interviews, New York : Great Reads Publishing, 2015.
2. Corfield Rebecca, Successful Interview Skills, New York: Kogan Page, 2006.
3. Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.
4. Butterfield Jeff, Soft Skills for Everyone, New Delhi: Cengage Learning, 2014.

15GE0XN JOURNALISM AND MASS COMMUNICATION

1 0 0 1

Course Objectives:
- To offer a basic knowledge of mass communication and its various forms
- To provide a basic understanding of mass communication in India

Course Outcomes (COs):
Students will be able to:
- Understand the underlying principles of Journalism
- Analyse the importance, functions and scope of mass communication
- Follow and adapt to the periodic changes in media

What is News - Components of a Newspaper - Structure of an Article - How to Write Headlines - Introduction to Script Writing - News Reporting - Advertising and Marketing - Online Journalism - Rules of Editing - Proof Reading - Optimization and Key Words - Media Ethics - TV Studies - Media Propaganda - Identifying Fake News - International Communication

Total: 15 hours

References:
1. Kumar, Keval. Mass Communication in India. IV Ed. Jaico Publishing House: 2012.
2. Agarwal, S.K.A Handbook of Journalism & Editorial Excellence.Jaico Publishing House: 2012.

15GE0XO VISUAL MEDIA AND FILMMAKING 1 0 0 1

Course Objectives:
- To acquire fundamental knowledge on development of film making as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Course Outcomes (COs):
Students will be able to:
- Understand the significance and techniques of visual medium
- Analyse and produce visual clippings

History of Cinema (Origin and Narrative) – Cinema as a visual medium -Significance of Editing – Styles of Editing – Editing as a methodology (Hollywood's Invisible Editing) – Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) – Different types of shots and angles – Film style and Narrative – (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) – Regional Cinema to National Cinema – Basics of Script Writing (Double and Single Column) – Basics of Video Production (script to screen) – Final submission of a script for five minutes short film.

Total: 15 hours

References:
1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

15GE0XP YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives
- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Course Outcome (COs)
- Understand the historical aspects and schools of yoga
- Ensure their physical & mental wellness through yoga practice
- Develop the power to concentrate and have stress free mind

What is Yoga – History of Yoga - Yoga in today's scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga -Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar - Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - Mudras-Relaxation - Pranayama - Meditation

15 Hours

References:
1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.

Websites:

1. *http://www.sarvyoga.com/*
2. http://www.wikihow.com/Do-Superbrain-Yoga

15GE0XQ CARNATIC MUSIC

1 0 0 1

Course Objectives:

- To know the basics of Carnatic Music
- To foster a blend of practical and theoretical understanding of Carnatic Vocal music
- To give a brief understanding of History of Indian Music, Evolution of the Raga system, Tala system, Structure of compositions

Course Outcomes (COs):

Students will be able to:

- Develop an understanding of the basics of Carnatic music
- Understand the aspects of Carnatic music which will help to create a strong foundation in Carnatic Music

History of Carnatic music - History of Carnatic Composers - Music Technical Terms Part I: Music, Nadam, Sangeetham, Marga Sangeetham, Suddha Sangeetham, Desiya Sangeetham, Kalpita, Kalpana, Ahata Nadam, Anahata Nadam, Shruthi, Swaram, Swarasthanas, Seven Swaras, Tamil Swaras, Prakruthi, Vikruthi, Kamala, Tivra, Twelve Swaras, Arohanam, Avarohanam, Swarna Kalas, Thala Symbols, Sthayi - Music Technical Terms Part II: Ragas, Janaka Ragas, Janya Ragas, Melakartha Ragas, Upanga Ragas, Bhashanga Ragas, Akshara Kalas, Sangathi, Anya Swaram, Chakras and Meanings, Jaaru, Poorvangam, Thadu and Madu, Saptaham, Ashtakam, Uthrangam, Gamaga, Abhyasa Ghanam, Sapta Kriyas, Nisapta Kriyas, Three Sathanas, Sabahaa gananas, Alapana, Thala, Laghu, Dhrutham - Jantavarisai - Classification (Raga, Thala, Instruments) -12 Melakartha Schemes – Practical Exercises in Music

Total: 15 hours

References:

1. Bhagyalekshmy, S. Ragas in Carnatic Music. CBH Publications, 2003.
2. Deva, Bigamudre Chaitanya. An Introduction to Indian Music. Publications Division, Ministry of Information and Broadcasting, Government of India, 2015.
3. Sambamoorthy, P. South Indian Music. Indian Music Pub. House, 1954.

15GE0XR GENERAL PSYCHOLOGY **1 0 0 1**

Course Objectives:

- To provide a basic understanding of psychology
- To understand the various methods and branches of psychology
- To explain social and work psychology of people and the need for mental health

Course Outcomes (COs):

Students will be able to:

- Understand the basics of human behavior in the workplace and society at large
- Identify the different fields of psychology and its uses
- Deal people effectively in their personal and social life

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude

Total: 15 hours

References:

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975.
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
3. Baron, R. A., Branscombe.N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016.
4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Dehi: Tata McGraw Hill. 1993.

15GE0XS NEURO BEHAVIOURAL SCIENCE 1 0 0 1

Course Objectives:

- Toprovide an introduction to the Cognitive Neuro Science of languages
- To provide an understanding of the Cognitive processes

Course Outcomes (COs):

The students will be able to:

- Identify the psychological problems that will impact mental health
- Value ethical conduct in professional and personal life
- Recognise the need for rationale and evidence in decision-making

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science - Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

Total: 15 hours

References:

1. Beck. Robert “Handbook of Physiology”. Vol I. Oxford University Press March 15, 1996.
2. Horon C Philip “Sexology and Mind”. Academic Press. 1993.
3. BlatteisM.Clark and Melvin J. Fregly Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996.

BRIDGE COURSES

15ECB01 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING

0 0 0 0

Course Objectives

- Provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve electrical and electronics engineering problems.
- Impart knowledge in the concept of electronic devices.
- Train students with good electrical and electronics engineering breadth so as to comprehend, analyze, design and create innovative products and solutions for the real life problems.

Course Outcomes (COs)

1. Predict the behaviour of any electrical circuits and discrete components.
2. Identify, formulate and solve electrical and electronics engineering problems
3. Identify the working principle of semiconductor diodes and its applications
4. Design different configurations of BJT
5. Perform different configurations of FET and UJT

UNIT I **10 Hours**

ELECTRICAL CIRCUITS AND ELECTRICAL MACHINES

Definition of Voltage, Current, Power & Energy, Ohms law, Kirchhoff's Law- simple problems, series & parallel circuits, generation of alternating EMF, definition of RMS value, average value, peak factor, form factor. Constructional details of DC Machines- Principle of operation of D.C. generator - EMF equation- Methods of excitation- Self and separately excited generators - Principle of operation of D.C. motor- Back EMF and torque equation.

UNIT II **10 Hours**

SEMICONDUCTOR DIODES AND BJT

PN junction Diode- Characteristics- Current Equation- -Half Wave Rectifiers - Full wave Rectifiers-efficiency, Ripple factor, form factor, Clippers and Clampers- Zener diode- Zener diode as voltage regulator-LED, Structure and working of bipolar junction transistor , CB, CC, CE configurations.

UNIT III **10 Hours**

FIELD EFFECT TRANSISTOR AND POWER DEVICES

Field Effect Transistors: Construction and characteristics of JFET- parameters of JFET - MOSFET-Depletion & enhancement modes, Construction, Theory of operation & characteristics of UJT-SCR characteristics and two transistor equivalent model, DIAC and TRIAC

Total: 30 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford Press, 2011.
2. R. Muthusubramaninan, S. Salivahanan and K. A. Muraleedharan, Basic Electrical, Electronics andComputer Engineering, Tata McGraw Hill, 2006.
3. J Millman, C. Halkias&Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill,2010.

4. L Robert Boylestead, Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education 2012.
5. J. A. Edminister, Electric Circuits,Schaum's Series, McGraw

15ECB02 CIRCUIT THEORY 0 0 0 0

Course Objectives

- Study the basic laws on Circuits and different elements used in Circuit.
- Gain knowledge on voltage and current in circuits using basic theorems.
- Understand the concepts of transients, resonance in series and parallel circuit and Graph theory techniques.

Course Outcomes (COs)

1. Evaluate the voltage, current and power for ac and dc electric circuit using Basic Laws.
2. Evaluate the voltage, current of electric circuit using Graph theory techniques.
3. Design simple network for the complex network by exploring circuit theorems
4. Design and test the dc and ac transient circuits using test signals.
5. Design and test series and parallel resonant circuit for a desired cut off frequency.

UNIT I **10 Hours**

BASICS OF CIRCUIT ANALYSIS

Basic components and electric circuits, voltage and current laws, Basic mesh and nodal analysis, source transformation techniques, Star delta transformation techniques, Phase relationship for R, L and C. Impedance, Admittance for R, L and C elements.

UNIT II **10 Hours**

NETWORK TOPOLOGIES AND THEOREMS

Concept of Duality, Dual network, Graphs of a network, Trees, twig, link and branches, Incidence matrix, Tie-set matrix formation and cut-set matrix formation of a graph. Linearity- Thevenin's theorem - Norton's theorem- Super position theorem- Maximum power transfer theorem- Reciprocity theorem - Compensation theorem- Tellegen's theorem- Millman's theorem.

UNIT III **10 Hours**

TRANSIENTS AND RESONANCE

Differential equations / Laplace Transform - Steady state and transient response: DC response of RL, RC and RLC circuit - Sinusoidal response of RL, RC and RLC circuits.Resonance: Natural frequency and Damping Ratio - Series Resonance - Parallel Resonance- Quality Factor.

Total: 30 Hours

Reference(s)

1. William Hayt, J V Jack, E Kemmerly and Steven M Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.
2. Joseph Edminister and MahmoodNahri, Theory and Problems of Electric Circuits Tata McGraw-Hill, 2008.
3. A Sudhakar, S Shyammohan and Palli, Circuits and Network (Analysis and synthesis) Tata McGraw-Hill, 2010.
4. L Robert Boylested, Experiments in Circuit Analysis to Accompany Introductory Circuit Analysis, PHI, 2002.

5. M .Russell, Mersereau and Joel R. Jackson, Circuit Analysis- A System Approach, Pearson Education, 2009.
6. Steven T. Karris, Circuit Analysis I with MATLAB Applications, Orchard Publications, 2004.

VALUE ADDED COURSES

15ECV01 EMBEDDED SYSTEM DESIGN USING 8051 & ARDUINO

Course Objectives

- To acquire the knowledge of embedded system design using 8051 and ARDUINO.

Course Outcomes (COs)

1. Analyze the architecture of 8051 and Arduino platform.
2. Discussing the Arduino experiments using Proteus.
3. Interfacing Arduino with various devices.

ARCHITECTURE OF 8051 & INTRODUCTION TO ARDUINO **10 Hours**

Architecture of 8051 - Timer & Counters of 8051 - Serial Communication in 8051 - Introduction to Arduino - Arduino Platform.

EMBEDDED SYSTEM DESIGN USING PROTEUS (8051 & ARDUINO) **15 Hours**

Introduction to KEIL & Proteus - Experiments in 8051 using keil and proteus- Experiments in Arduino using proteus.

HARDWARE IMPLEMENTATION USING ARDUINO **15 Hours**

LED blinking - LED control by switches - Interfacing with LCD - Interfacing with Ultrasonic sensor - Interfacing with temperature sensor - Interfacing with humidity sensor - Interfacing with Bluetooth - Interfacing with Camera - Interfacing Wi-Fi

MINI PROJECT

Total: 40 Hours

Reference(s)

1. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, 2004.
2. Tianhong Pan, Yi Zhu, Designing Embedded Systems with Arduino: A Fundamental Technology for Makers, Springer Singapore, 24-Jun-2017

15ECV02 DIGITAL IC DESIGN & IMPLEMENTATION

Course Objectives

- To understand the design of digital integrated circuits and its implementation.

Course Outcomes (COs)

1. Design of Advanced Digital Systems.
2. Programming and Implementation of FPGAS and ASICS.

ADVANCED DIGITAL DESIGN **10 Hours**

Basics of Digital Electronics – Arithmetic Unit – Data Processing Unit – Advanced Sequential Logic – FSM - Memory Design – VLSI Design Flow - Fabrication - Design Issues – Parameters – Methods of Implementation

ADVANCED FPGA PROGRAMMING **10 Hours**
Basic Verilog Modelling - Verilog Test Benches - FSM – Memory

FPGA IMPLEMENTATION **10 Hours**
Implementation of Digital circuits –Methods: Schematic – HDL – Coregenerator - System Generator – Chipscope Pro – Vivado Suite

ASIC IMPLEMENTATION **10 Hours**
Implementation of Digital circuits – Cadence Digital Flow – Microwind EDA

MINI PROJECT
Project Specification Analysis – Understanding the Architecture – Design – HDL Code – Implementation – Analysis.

Total : 40 Hours

Reference(s)

1. Jari Nurmi, Processor Design: System-On-Chip Computing for ASICs and FPGAs, Springer, 2007.
2. Seetharaman Ramachandran, Digital VLSI Systems Design: A Design Manual for Implementation of Projects on FPGAs and ASICs using Verilog, Springer, 2007.

15ECV03 ELECTRONIC RAPID PROTOTYPING

Course Objectives

- To understand the design of PCB using OrCAD Software.

Course Outcomes (COs)

1. Create and Configure simulation profiles.
2. Generate and create footprint using OrCAD tools.
3. Prototyping for real time applications.

ORCAD SOFTWARE **7 Hours**
Introduction to Printed Circuit Board, Types of PCBs, Introduction to OrCAD Software, Getting started with OrCAD Capture, Tools in OrCAD Capture, Design Preparation, Building simple Schematics, Building multiple page schematics.

SIMULATION ANALYSIS **7 Hours**
PSPICE Netlist creation, Error identification and rectification, Creation and configuration of Simulation profile, Bias Point analysis, Transient analysis, Single Window and Multi window representation, Parametric analysis, DC Sweep analysis, AC Sweep analysis.

ORCAD TOOLS **9 Hours**
Various tools in OrCAD layout, Generation of .max file for the schematic, Introduction to Footprint creation, Creation of a footprint for the new part generated, Importing Netlist and Placement, Creation of a board outline, Placement of components, Manual/Auto Routing, Gerber generation.

MITS MACHINE **9 Hours**
Introduction to PCB Prototyping Machines, Parts and components of MITS Machine, Accessories of MITS Machine, Milling and drilling tools, Different types of Copper Boards,, Fabrication of Basic PCBs, Introduction to two layer PCB fabrication.

PROTOTYPING **8 Hours**

Half wave rectifier, Full wave rectifier, 5V Power Supply, Astable Multivibrator, Monostable Multivibrator, RC Phase shift Oscillator, Automatic Street Light, Traffic Light, Touch sensitive to Melody Alarm, Ambulance sirens circuit, Decoration LED, FM Modulator and Demodulator, Bulgar Alarm, Real time applications.

Total: 40 Hours

Reference(s)

1. Kraig Mitzner, Complete PCB Design using OrCAD Capture and Layout, Newnes, 2007.
2. Muhammad H. Rashid, Introduction to Pspice Using Orcad for Circuits and Electronics, PHI Learning, 2005
3. OrCAD 16.5 Tutorials (Available with the Software Package)
4. OrCAD 16. 5 Help (Available with the Software Package)
5. OrCAD 16. 5 Users Guide (Available with the Software Package)
6. http://userweb.eng.gla.ac.uk/john.davies/orcad/

15ECV04 PIC AND MSP430 MICROCONTROLLERS

Course Objectives

- To understand thearchitecture and functions of PIC and MSP430 Microcontrollers.

Course Outcomes (COs)

1. Analyze the architecture of MSP430 and its applications.
2. Developing the programming skills of MSP430 using Embedded C.
3. Realizing the usages of timers, ADC and displays using MSP430.

ARCHITECTURE OF THE MSP430 PROCESSOR **7 Hours**

Central Processing Unit - Addressing Modes - Constant Generator and Emulated Instructions - Instruction Set - Examples - Reflections on the CPU and Instruction Set – Resets - Clock System.

FUNCTIONS, INTERRUPTS, AND LOW-POWER MODES **7 Hours**

Functions and Subroutines - Subroutine Calls- Storage for Local Variables - Passing Parameters to a Subroutine and Returning a Result - Mixing C and Assembly Language – Interrupts - Interrupt Request - Interrupt Service Routines - Issues Associated with Interrupts-Low-Power Modes of Operation.

DIGITAL INPUT, OUTPUT, AND DISPLAYS **8 Hours**

Digital Input and Output: Parallel Ports - Digital Inputs - Switch Debounce - Digital Outputs - Interface between 3V and 5V Systems - Driving Heavier Loads - Liquid Crystal Displays - Driving an LCD from an MSP430x4xx - Simple Applications of the LCD

TIMERS **8 Hours**

Watchdog Timer - Basic Timer1 - Timer_A - Measurement in the Capture Mode - Output in the Continuous Mode - Output in the Up Mode: Edge-Aligned Pulse-Width Modulation - Output in the Up/Down Mode: Centered Pulse-Width Modulation - Operation of Timer_A in the Sampling Mode - Timer_B - Setting the Real-Time Clock: State Machines.

MIXED-SIGNAL SYSTEMS: ANALOG INPUT AND OUTPUT **10 Hours**

Comparator_A- Analog-to-Digital Conversion: General Issues - Analog-to-Digital Conversion: Successive Approximation - The ADC10 Successive-Approximation ADC - Basic Operation of the ADC10 - More Advanced Operation of the ADC10 - The ADC12 Successive-Approximation ADC -

Analog-to-Digital Conversion: Sigma–Delta - The SD16_A Sigma–Delta ADC - Operation of SD16_A - Signal Conditioning and Operational Amplifiers - Digital-to-Analog Conversion.

Total : 40 Hours

Reference(s)

1. John H.Davies, *MSP430 Microcontroller Basics*, Newnes Publishers, 2008.
2. www.newnepress.com

15ECV05 PROGRAMMABLE LOGIC CONTROLLERS

Course Objectives

- To understand the basic architecture and programming of Programmable Logic Controllers.

Course Outcomes (COs)

1. Determine the fundamentals of PLC and its architecture.
2. Developing PLC applications with the knowledge of programming skills.
3. Realizing the usages of timers, relays and able to identify their applications.

ARCHITECTURE OF PLC **6 Hours**

Fundamentals of programmable logic controller – Functions of PLCs – PLC operations – Evaluation of the modern PLC – Memory– Selection of PLC – Features of PLC – Architecture

BASICS OF PLC PROGRAMMING **6 Hours**

Basics of PLC programming – Developing Fundamental wiring diagrams – Problem solving using logic ladder diagrams – communication in PLCs – Programming Timers – Programming counters – Data Handling

INTRODUCTION TO FACTORY AUTOMATION **5 Hours**

History and developments in industrial automation. Vertical integration of industrial automation, control elements in industrial automation

PROGRAMMING OF PLC **10 Hours**

Types of Programming - Simple process control programs using Relay Ladder Logic - PLC arithmetic functions - Timers and counters –data transfer-comparison and manipulation instructions, PID instructions, PTO / PWM generation.

INSTALLATION **13 Hours**

Installation and maintenance procedures for PLC - Troubleshooting of PLC, PLC Networking-Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet. Case studies of Machine automation, Process automation, Selection parameters for PLC. Introduction to Programmable Automation Controller.

Total : 40 Hours

Reference(s)

1. John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella “Programmable Logic Controllers ", McGraw Hill Inc, 2005
3. Frank D. Petro Zella, “Programmable logic controller” McGraw – Hill Publications, 1998.
4. Bolton W., “Mechatronics”, Pearson Education, 2009.
5. Kelvin T Erikson, “Programmable Logic Controllers ", Dogwood Valley Press, 2005.

15ECV06 JAVA PROGRAMMING

Course Objectives

- To understand the basic concepts of JAVA programming and its implementation.

Course Outcomes (COs)

1. Solve the basic design problems using object and classes.
2. Demonstrate the concepts of OOPs
3. Design programs using applet and event handling.

JAVA BASICS AND MULTITHREADED PROGRAMMING **8 Hours**

History & Evolution of Java Overview of Java - Data Types, Variables, and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes. Inheritance Basic – Super – Multilevel – Method overriding – Abstract Classes - Packages Basics – Access protection – Importing – Interfaces.
Definitions and Implementations - Exception Handling- Types – Try and Catch – Throw – Throws - Multithreaded Programming – Synchronization -Inter thread Communication Multithreading, Synchronization.

GENERICS AND I/O STREAMS **8 Hours**

Enumerations - Autoboxing, - Annotations - Simple Generics – Generic Class – I/O Classes and Interfaces - File – The Byte Streams – The Character Streams - Using Stream I/ O – Serialization. Collection classes.

THE JAVA LIBRARY **8 Hours**

String Handling – Special String operations and Methods – String Buffer - primitive type Wrappers – System – Math -Collections Interfaces and Classes - Date and Time – Formatter – Database Connectivity -Networking. String operations and Windows Controls.

APPLETS, EVENT HANDLING AND AWT **8 Hours**

Applet Basics – Applet Architecture – Applet Display Methods – Parameter Passing – Event Handling Mechanisms – Event Classes – Event Listener – Working with Windows , Graphics , Fonts and Colors – AWT Controls – Layout Managers and Menus. AWT(Abstract Windows Toolkit) Controls.

IMPLEMENTATION OF ALGORITHMS USING JAVA **8 Hours**

Backtracking – n-Queen's Problem – Hamiltonian Circuit problem – Subset-Sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem. Searching and Sorting Algorithms.

Total: 40 Hours

Reference(s)

1. Herbert Schildt, Java -Complete Reference, 8th edition Tata McGraw Hill, 2011.
2. Kathy sierra and Bert Bates Head First Java second edition, Oreilly, 2010.
3. Harvey M. Deitel and Paul J. Deitel, Java How to Program, Prentice Hall of India, 2010.
4. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008.
5. Herbert Schildt, Java(R) 7, A Beginners Guide, Tata McGraw Hill, 2010.

15ECV07 OBJECT ORIENTED PROGRAMMING C++

Course Objectives

- To understand the basic concepts of JAVA programming and its implementation.

Course Outcomes (COs)

1. Develop the programming skills of students in OOPS.
2. Analyze the basic concepts of objects and classes.
3. Implement file concepts and operations

INTRODUCTION **8 Hours**

Need for object oriented programming – Procedural Languages vs. Object oriented approach - Characteristics Object oriented programming - C++ Programming Basics: Basic Program Construction - Output Using Cout - Input with Cin - Data types-Variables and Constants – Operators -Control Statements-Manipulators-Type conversion. Survey of programming techniques- Unstructured, Modular, Procedural and Object Oriented.

OBJECTS AND CLASSES **8 Hours**

Simple Class - C++ Objects as Physical Objects – C++ Object as Data types- Constructors and Destructors Object as Function Arguments - Returning Objects from Functions - Structures and Classes - Arrays and Strings. Default arguments.

OPERATOR OVERLOADING AND INHERITANCE **8 Hours**

Need of operator overloading - Overloading Unary Operators - Overloading binary Operators- Overloading Special Operators - Data Conversion- Inheritance: Derived Class and Base Class-Derived Class Constructors Overriding Member Functions-Class Hierarchies - Public and Private Inheritance-Levels of Inheritance Multiple Inheritance. Function Overloading.

POLYMORPHISM AND FILE STREAMS **8 Hours**

Virtual Function – Friend Function – Static Function-Assignment and Copy Initialization- Memory Management: new and delete-Pointers to Objects, this Pointer- Streams – String I/O – Character I/O – Object I/O – I/O with Multiple Objects – File Pointers – Disk I/O with Member Functions- Error Handling in File I/O. Abstract Classes and Friend Functions.

TEMPLATES AND EXCEPTION HANDLING **8 Hours**

Templates: Introduction - Function Templates - Overloading Function Templates - Class Templates - Exception Handling – Syntax, multiple exceptions, exceptions with arguments-Multifile Programs.

Total: 40 Hours

Reference(s)

1. Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication, New Delhi, 2009.
2. Deitel and Deitel, C++ How to program, Prentice Hall, New Delhi,2005.
3. D.S.Malik, C++ Programming, Thomson, New Delhi, 2007.
4. K.R.Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGrawHill, New Delhi, 2006.

15ECV08 RF CIRCUIT DESIGN USING ADS

Course Objectives

- To understand the concepts of designing ICs at RF and microwave frequencies using ADS.

Course Outcomes (COs)

1. Analyze the performance characteristics of transmission lines at radio frequencies.
2. Design the Micro strip filters using Richard’s transformation and Kuroda’s identities .
3. Design the impedance matching networks.

INTRODUCTION TO IC DESIGN AT RF AND MICROWAVE FREQUENCIES **10 Hours**
Transmission line behaviour and its analysis at radio frequencies – design considerations –Wave propagation in micro strip line – Empirical formulas for effective dielectric constant, characteristic impedance, wavelength, attenuation factors –MIC materials – substrate, conductor, dielectric, resistive films–RF and microwave measurement tools.

DESIGN OF FILTERS **15 Hours**
Filter design with discrete components, frequency transformation, denormalization of low pass design, butterworth and chebyshev filter realization, micro strip filter design using Richard's transformation and kuroda's identities, cascading filters.

DESIGN OF IMPEDANCE MATCHING NETWORK **15 Hours**
Impedance matching-design of matching networks using lumped elements – L and T matching networks – matching network design using distributed elements – stub matching.

MINI PROJECT

Total : 40 Hours

Reference(s)

1. David M. Pozar, Microwave Engineering, Wiley, 2004.

15ECV09 INTERACTIVE APPLICATIONS IN MATLAB GUI AND SIMULINK

Course Objectives

- To understand the basics of MATLAB GUI and to use Simulink for Signal and Image Processing Applications.
- To acquire knowledge for creating models in Communication Theory and VLSI systems using Simulink.

Course Outcomes

1. Identify the fundamental steps to use MATLAB GUI and Simulink environment.
2. Create the model and GUI for Signal Processing Applications.
3. Implement the Image Processing Algorithms through Simulink and GUI.
4. Apply the concept of Communication Theory to create the model/GUI for Communication Systems Applications.
5. Design and Implement the VLSI systems using Simulink and GUI.

Unit I **9 Hours**
INTRODUCTION
MATLAB GUI: Overview- Predefined dialog boxes – M-file dialog boxes- Dialog Box summary – GUI object Hierarchy- GUI creation fundamentals- GUI object size and Position – Capturing mouse actions – Event Queue – Callback Programming – M-file examples- GUIDE.
Simulink: Overview–Simulink Library- Create and Simulate a model - Using the model – Concept of file import/ export.

Unit II **9 Hours**
SIGNAL PROCESSING
Overview on Signal processing toolbox **-** Create model and GUI for signal processing applications: Convolution and Correlation of given sequence, FFT of given signal, Design of Multirate filters, Adaptive Noise Cancellation, Spectral analysis using Periodogram.

Unit III **9 Hours**
IMAGE PROCESSING
Overview on Image processing toolbox -Create model and GUI for Image processing applications: De-noising, Image Segmentation using Edge Detection, Adaptive Thresholding, Image compression using DCT, Design of Median Filtering, Image Enhancement using Histogram Equalization.

Unit IV **9 Hours**
COMMUNICATION SYSTEMS
Overview on Communication system toolbox - Create model and GUI for Communication system applications: Amplitude Modulator and Demodulator, Comparison of amplitude modulation techniques, Verification of Sampling Theorem, Pulse Amplitude Modulator and Demodulator, Digital Modulation and Demodulation techniques, Multiplexing and Demultiplexing.

Unit V **9 Hours**
VLSI
Overview on VLSI toolbox **-**Create model and GUI for VLSI applications: HDL Code Generation from Simulink, Multiplier circuits, Digital controllers, FIR filter using Verilog HDL on FPGA, & analysis using Matlab, MAC unit implemented in Simulink

Total: 45 Hours

References

1. Partha S. Mallick, “MATLAB and Simulink Introduction to Applications”, 2009.
2. Duane Hanselman and Bruce Littlefield, “Mastering MATLAB 7”, Pearson Education, 2005.

15ECV10 RFID INTERFACING WITH PIC16F877A

Course Objectives

- To understand the concepts of RFID interfacing with PIC16F877A using ORCAD software.

Course Outcomes (COs)

1. Identify the concepts related with wireless communication and RF module.
2. Analyze the features of PIC16F877A Microcontroller for interfacing
3. Design and configure the controller for interfacing with RFID.

INTRODUCTION TO WIRELESS COMMUNICATION & RF MODULE **10 Hours**
Wireless – Examples of wireless devices- RF Module - RF Module’s performance – Scope of wireless RF Module – Features of RF Module – Hardware and Software requirements.

PIC16F877A MICROCONTROLLER **15 Hours**
Microcontroller features – Peripheral Features – CMOS Technology – Data space – PIN diagram – Memory organization – Core Architecture – USART.

RFID INTERFACING WITH PIC MICROCONTROLLER **15 Hours**
EM-18 RF module – Working - PIC16F877A configurations – Circuit Diagram – LCD and UART functions – Programming code.

MINI PROJECT

Total : 40 Hours

Reference(s)

1. Subrata Ghoshal, “Microcontroller: Internnals, Instructions, Programming and Interfacing”, Pearson education, 2010.
2. Bill Glover, Himanshu Bhatt, “RFID Essentials”, O’reilly media, 2006.

15ECV11 MATLAB APPLICATIONS IN ENGINEERING

Course Objectives

- To understand the MATLAB tool that are essential in solving engineering problems
- To illustrate the problem-solving process through an engineering examples and applications.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Use MATLAB to solve computational problems
2. Carry out numerical computations and analyses
3. Identify the fundamental steps to use MATLAB GUI and Simulink environment.

Unit I **9 Hours**
INTRODUCTION
Menus and the toolbar -Computing with MATLAB -MATLAB Help System -Programming in MATLAB – Scalars, Vectors and Matrices-Scalars and array operations- Probability and Statistics -Relational Operators and Logical Variables- Logical Operators and Functions-Conditional Statements -Plotting Capabilities-Linear and Logarithmic plots-Multiple plots-Line and Mark Style-Axes Scaling

Unit II **9 Hours**
MATLAB FUNCTIONS AND MATRICES
Mathematical Function-Data analysis functions-selection statements and selection functions-Speech signal analysis-User defined functions-Random number generation functions-Matrix manipulation functions-Loops-Matrix Operations-Matrix Functions-Matrix inverse and Ranking-Determinants-Eigenvectors and Eigen values-Decompositions-Singular value Decomposition

Unit III **9 Hours**
NUMERICAL TECHNIQUES AND SYMBOLIC MATHEMATICS
Solutions to systems of Linear Equations-Graphical Interpretation-Solutions using matrix operations-Numerical Integration and Differentiation-Ordinary differential equations-First order differential equations-Higher order Differential Equations-Symbolic Processing-Equation Solving-Differentiation and Integration.

Unit IV **9 Hours**

1D AND 2D SIGNAL PROCESSING

Overview on Signal processing toolbox -Generating basic signals: sine, cosine, triangular, square waves - operations on signals- Sampling-Noise in 1D signals-Filtering process -2D signal processing-simple 2D signal enhancement techniques-arithmetic operations-noise in 2D signals -filtering process

Unit V **9 Hours**

MATLAB GUI: OVERVIEW

Predefined dialog boxes – M-file dialog boxes- Dialog Box summary – GUI object Hierarchy- GUI creation fundamentals- GUI object size and Position – Capturing mouse actions – Event Queue – Callback Programming – M-file examples- GUIDE.

Simulink: Overview–Simulink Library- Create and Simulate a model - Using the model – Concept of file import/ export.

Total: 45 Hours

Reference(s):

1. William J. Palm III, “Introduction to MATLAB 6 for Engineers”, McGraw Hill 2000.
2. Delores M. Etter, “Engineering Problem Solving with MATLAB”, Prentice Hall, Second Edition.
3. Partha S. Mallick, “MATLAB and Simulink Introduction to Applications”, 2009.
4. Duane Hanselman and Bruce Littlefield, “Mastering MATLAB 7”, Pearson Education, 2005.