B.E. (Electronics and Communication Engineering)

2018 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai

Approved by AICTE - NAAC with 'A' Grade)

SATHYAMANGALAM – 638 401 Erode District Tamil Nadu

Phone : 04295 226000 Fax : 04295 226666

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

CONTENTS

BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2018

(CHOICE BASED CREDIT SYSTEM)

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

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2018-2019 for Regular admission (Academic year 2019-2020 for Lateral Entry) and subsequently.

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

1. ADMISSION

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

1.1 Regular Admission

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

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

(or)

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

1.2 Lateral Entry Admission

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

(or)

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

2. PROGRAMMES OFFERED

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

B. E. Programmes

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

B. Tech. Programmes

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

3. STRUCTURE OF THE PROGRAMME

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

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

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

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

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

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

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

3.2 Each course is normally assigned a certain number of credits based on the following

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

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

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

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.

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

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

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

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

3.9 **Industrial Training / Internship**

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

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

3.10 **Socially Relevant Projects**

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

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

4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

5. DURATION OF THE PROGRAMME

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

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

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

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

6. COURSE ENROLLMENT AND REGISTRATION

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

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

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

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

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

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

semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

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

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.4.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

6.5 Reappearance Registration

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

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

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

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

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

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

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

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

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

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

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

7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/

International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

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

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

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

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

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

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a Faculty member of the Department who shall function as Faculty Advisor

for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The Faculty Advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor shall be:

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

9. COMMITTEES

9.1 Common Course Committee

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

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

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

9.2 Class Committee Meeting

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

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

10. SYSTEM OF EXAMINATION

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

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

10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2.

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

11. PASSING REQUIREMENTS AND PROVISIONS

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

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

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

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

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

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

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

Branch of Study	Minimum Credits	
	Regular Admission	Lateral Entry
B.E. Programmes		
Aeronautical Engineering	172	135
Agricultural Engineering	172	134
Automobile Engineering	170	133
Civil Engineering	171	133
Computer Science and Engineering	171	133
Electronics and Communication Engineering	172	131
Electrical and Electronics Engineering	170	131
Electronics and Instrumentation Engineering	170	131
Mechanical Engineering	170	131
Mechatronics	170	132
B.Tech. Programmes		
Biotechnology	172	134
Fashion Technology	172	134
Food Technology	170	132
Information Technology	170	132
Textile Technology	171	133

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

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

12. ASSESSMENT AND AWARD OF LETTER GRADES

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

12.2 Credit Point is the product of Grade Point and number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

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

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

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

'RA' ---Reappearance registration is required for that particular course

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

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

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

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

Where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

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

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

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

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

12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

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

12.10 **Eligibility for the Award of Degree**

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

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

13. CLASSIFICATION OF THE DEGREE AWARDED

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

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

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

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

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

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

14. WITHDRAWAL FROM THE EXAMINATION

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

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

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

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

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

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

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

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

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

requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

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

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

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

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

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

16. SCHEME OF ASSESSMENT

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

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	End Semester Examination	**50**
	Total Marks	**100**

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

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

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

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

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

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

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

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

VIII	**INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Assessment by Industry	**30**
	Viva-voce	**20**
	Presentation	**30**
	Case Study / Report	**20**
	Total Marks	**100**
IX	**SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	
X	**VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	
XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Exercise (Minimum 10 Exercises/Modelling)	**60**
	Model Examination	**40**
	Total Marks	**100**

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

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

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

18. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

19. DISCIPLINE

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

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

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

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

PROGRAMME EDUCATIONAL 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)

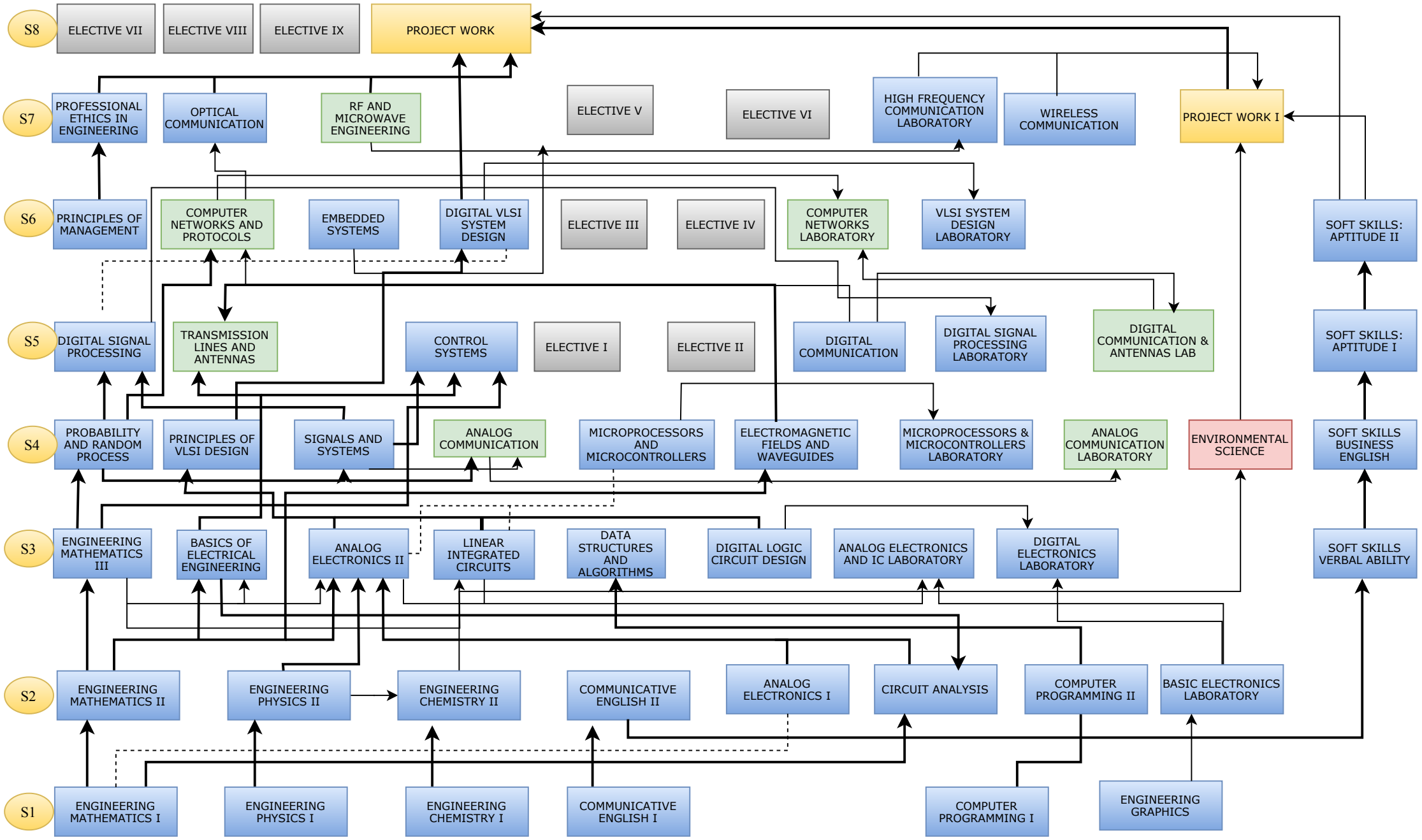
1. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
2. Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial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

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
I	x	x	x	x	x	x	x				x	x	x	x	x
II			x	x		x	x				x	x	x	x	x
III								x	x	x	x				x
IV				x	x	x					x	x	x	x	x
V			x	x	x	x	x				x		x	x	x

CURRICULUM DESIGN & INTERLINKING OF COURSES 2018 R

General Electives (I to IX) are the courses offered by the departments that do not require any kind of prerequisite. It depends upon the students' interest.



DEPARTMENT OF ECE **Minimum Credits to be Earned : 172**										
I SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EC101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18EC102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18EC103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18EC104	COMPUTER PROGRAMMING I	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HS
18EC106	ENGINEERING GRAPHICS	1	0	4	3	4	100	0	100	ES
Total		**11**	**1**	**12**	**18**	**23**	**400**	**200**	**600**	**-**
II SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EC201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18EC202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18EC203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18EC204	CIRCUIT ANALYSIS	3	1	0	4	4	50	50	100	ES
	LANGUAGE ELECTIVE	-	-	-	2	3	100	0	100	HS
18EC206	ANALOG ELECTRONICS I	3	0	0	3	3	50	50	100	ES
18EC207	COMPUTER PROGRAMMING II	2	0	2	3	4	50	50	100	ES
18EC208	BASIC ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	ES
Total		**15**	**2**	**8**	**23**	**28**	**500**	**300**	**800**	**-**

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EC301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18EC302	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18EC303	DIGITAL LOGIC CIRCUIT DESIGN	3	1	0	4	4	50	50	100	PC
18EC304	ANALOG ELECTRONICS II	3	1	0	4	4	50	50	100	ES
18EC305	LINEAR INTEGRATED CIRCUITS	3	0	0	3	3	50	50	100	PC
18EC306	DATA STRUCTURES AND ALGORITHMS	2	0	2	3	4	50	50	100	ES
18EC307	ANALOG ELECTRONICS & IC LABORATORY	0	0	2	1	2	100	0	100	PC
18EC308	DIGITAL ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**16**	**3**	**10**	**23**	**29**	**600**	**300**	**900**	**-**
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EC401	PROBABILITY AND RANDOM PROCESS	3	1	0	4	4	50	50	100	BS
18EC402	SIGNALS AND SYSTEMS	3	1	0	4	4	50	50	100	PC
18EC403	ANALOG COMMUNICATION	3	0	0	3	3	50	50	100	PC
18EC404	PRINCIPLES OF VLSI DESIGN	3	0	0	3	3	50	50	100	PC
18EC405	ELECTROMAGNETIC FIELDS AND WAVEGUIDES	3	1	0	4	4	50	50	100	PC
18EC406	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3	3	50	50	100	PC
18EC407	ANALOG COMMUNICATION LABORATORY	0	0	2	1	2	100	0	100	PC
18EC408	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	2	1	2	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**20**	**3**	**6**	**23**	**29**	**700**	**300**	**1000**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EC501	DIGITAL COMMUNICATION	3	1	0	4	4	50	50	100	PC
18EC502	DIGITAL SIGNAL PROCESSING	3	1	0	4	4	50	50	100	PC
18EC503	TRANSMISSION LINES AND ANTENNAS	3	1	0	4	4	50	50	100	PC
18EC504	CONTROL SYSTEMS	3	1	0	4	4	50	50	100	ES
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	50	50	100	PE
18EC507	DIGITAL SIGNAL PROCESSING LABORATORY	0	0	2	1	2	100	0	100	PC
18EC508	DIGITAL COMMUNICATION AND ANTENNAS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**4**	**6**	**24**	**28**	**600**	**300**	**900**	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HS
18EC602	COMPUTER NETWORKS AND PROTOCOLS	3	0	0	3	3	50	50	100	PC
18EC603	DIGITAL VLSI SYSTEM DESIGN	3	0	0	3	3	50	50	100	PC
18EC604	EMBEDDED SYSTEMS	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	50	50	100	PE
18EC607	COMPUTER NETWORKS LABORATORY	0	0	2	1	2	100	0	100	PC
18EC608	VLSI DESIGN LABORATORY	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**0**	**8**	**20**	**25**	**600**	**300**	**900**	-

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	50	50	100	HS
18EC702	WIRELESS COMMUNICATION	3	0	2	4	5	50	50	100	PC
18EC703	RF AND MICROWAVE ENGINEERING	3	1	0	4	4	50	50	100	PC
18EC704	OPTICAL COMMUNICATION	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	50	50	100	PE
18EC707	HIGH FREQUENCY COMMUNICATION LABORATORY	0	0	2	1	2	100	0	100	PC
18EC708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**17**	**1**	**10**	**23**	**28**	**450**	**350**	**800**	**-**
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	50	50	100	PE
18EC804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**9**	**0**	**18**	**18**	**27**	**200**	**200**	**400**	**-**

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
18GE0P1	NANOMATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P4	BIO-PHOTONICS	3	0	0	3	3	50	50	100	BS
18GE0P5	PHYSICS OF SOFT MATTER	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	50	50	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	50	50	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	50	50	100	BS
ENTREPRENEURSHIP ELECTIVES										
18GE0E1	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	50	50	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	50	50	100	PE

DISCIPLINE ELECTIVES										
18EC001	ANALOG VLSI DESIGN	3	0	0	3	3	50	50	100	PE
18EC002	IC DESIGN FOR DSP	3	0	0	3	3	50	50	100	PE
18EC003	LOW POWER VLSI DESIGN	3	0	0	3	3	50	50	100	PE
18EC004	VLSI VERIFICATION & TESTING	3	0	0	3	3	50	50	100	PE
18EC005	VLSI PHYSICAL DESIGN	3	0	0	3	3	50	50	100	PE
18EC006	WAVELET TRANSFORMS AND APPLICATIONS	3	0	0	3	3	50	50	100	PE
18EC007	VIRTUAL INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EC008	MACHINE VISION	3	0	0	3	3	50	50	100	PE
18EC009	DSP STRUCTURE FOR VLSI	3	0	0	3	3	50	50	100	PE
18EC010	SPEECH SIGNAL PROCESSING	3	0	0	3	3	50	50	100	PE
18EC011	STATISTICAL SIGNAL PROCESSING	3	0	0	3	3	50	50	100	PE
18EC012	NEXT GENERATION NETWORKS	3	0	0	3	3	50	50	100	PE
18EC013	CRYPTOGRAPHY & NETWORK SECURITY	3	0	0	3	3	50	50	100	PE
18EC014	SATELLITE COMMUNICATION	3	0	0	3	3	50	50	100	PE
18EC015	NETWORK PROTOCOL ENGINEERING	3	0	0	3	3	50	50	100	PE
18EC016	DATA COMMUNICATION & NETWORKS	3	0	0	3	3	50	50	100	PE
18EC017	ELECTRONIC PRODUCT DESIGN	3	0	0	3	3	50	50	100	PE
18EC018	EMBEDDED NETWORKS AND PROTOCOLS	3	0	0	3	3	50	50	100	PE
18EC019	REAL TIME OPERATING SYSTEMS	3	0	0	3	3	50	50	100	PE
18EC020	INTERNET OF THINGS	3	0	0	3	3	50	50	100	PE
18EC021	WIRELESS SENSOR NETWORKS	3	0	0	3	3	50	50	100	PE
18EC022	ARM ARCHITECTURE AND PROGRAMMING	3	0	0	3	3	50	50	100	PE
18EC023	FUZZY SYSTEMS AND APPLICATIONS	3	0	0	3	3	50	50	100	PE
18EC024	MACHINE LEARNING TECHNIQUES	3	0	0	3	3	50	50	100	PE
18EC025	ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS	3	0	0	3	3	50	50	100	PE
18EC026	INDUSTRIAL AUTOMATION	3	0	0	3	3	50	50	100	PE

18EC027	DEEP LEARNING TECHNIQUES	3	0	0	3	3	50	50	100	PE
18EC028	PATTERN RECOGNITION	3	0	0	3	3	50	50	100	PE
18EC029	COMPUTER ARCHITECTURE	3	0	0	3	3	50	50	100	PE
18EC030	AUTOMOTIVE ELECTRONICS AND NETWORKING	3	0	0	3	3	50	50	100	PE
18EC031	MEDICAL ELECTRONICS AND INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EC032	CONSUMER ELECTRONICS	3	0	0	3	3	50	50	100	PE
18EC033	NANO ELECTRONICS	3	0	0	3	3	50	50	100	PE
18EC034	LIQUID CRYSTALS AND APPLICATIONS	3	0	0	3	3	50	50	100	PE
18EC035	MEMS	3	0	0	3	3	50	50	100	PE
18EC036	MEASUREMENT AND INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EC037	DIGITAL IMAGE PROCESSING	3	0	0	3	3	50	50	100	PE
18EC038	MEDICAL IMAGE PROCESSING	3	0	0	3	3	50	50	100	PE
18EC039	BIO SIGNAL PROCESSING	3	0	0	3	3	50	50	100	PE
OPEN ELECTIVES										
18EC0YA	BASICS OF ANALOG AND DIGITAL ELECTRONICS	3	0	0	3	3	50	50	100	OE
18EC0YB	AUTOMOTIVE ELECTRONICS	3	0	0	3	3	50	50	100	OE
18EC0YC	PCB DESIGN AND PROTOTYPING	3	0	0	3	3	50	50	100	OE
18EC0YD	MICROCONTROLLER PROGRAMMING	3	0	0	3	3	50	50	100	OE
18EC0YE	ENGINEERING COMPUTATION WITH MATLAB	3	0	0	3	3	50	50	100	OE
18EC0YF	BASICS OF HARDWARE DESCRIPTION LANGUAGES	3	0	0	3	3	50	50	100	OE
18EC0YG	FUNDAMENTALS OF EMBEDDED SYSTEMS	3	0	0	3	3	50	50	100	OE
18EC0YH	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3	3	50	50	100	OE
18EC0YI	ELECTRONIC PRODUCT DESIGN AND PACKAGING	3	0	0	3	3	50	50	100	OE
18EC0YJ	PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS	3	0	0	3	3	50	50	100	OE

ADDITIONAL ONE CREDIT COURSES										
18GE0XA	ETYMOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	-	-	-	1	-	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	-	-	-	1	-	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	-	-	-	1	-	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	-	-	-	1	-	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	-	-	-	1	-	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	-	1	-	100	0	100	EEC
18GE0XI	BLOG WRITING	-	-	-	1	-	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	-	-	-	1	-	100	0	100	EEC
18GE0XK	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	-	1	-	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	-	-	-	1	-	100	0	100	EEC
18GE0XM	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	-	-	-	1	-	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XP	FM RADIO BROADCASTING TECHNOLOGY	-	-	-	1	-	100	0	100	EEC
ONE CREDIT COURSES										
18EC0XA	SIGNAL PROCESSING TECHNIQUES USING LABVIEW	-	-	-	1	-	100	0	100	EEC
18EC0XB	ANN AND FUZZY LOGIC APPLICATIONS	-	-	-	1	-	100	0	100	EEC
18EC0XC	M2M TECHNIQUE FOR SMART CITIES	-	-	-	1	-	100	0	100	EEC
18EC0XD	LABVIEW BASED MACHINE LEARNING	-	-	-	1	-	100	0	100	EEC
18EC0XE	EMBEDDED SYSTEM DESIGN FOR ROBOTICS	-	-	-	1	-	100	0	100	EEC
18EC0XF	INDUSTRIAL VISION INSPECTION SYSTEM	-	-	-	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4	-	-	-	-	28	16	15%	20%
2	ES	6	11	10	-	4	-	-	-	31	18	15%	20%
3	HSS	2	2	-	-	-	2	2	-	8	5	5%	10%
4	PC -		-	9	19	14	12	12	-	66	38	30%	40%
5	PE	-	-	-	-	6	6	6	9	27	16	15%	20%
6	EEC	-	-	-	-	-	-	3	9	12	7	7%	10%
Total		18	23	23	23	24	20	23	18	172	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

18EC101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

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

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors
2. Analyse various types of functions and their differentiation techniques involved in engineering fields
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

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

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

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

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

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

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

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

UNIT V **9 Hours**

COMPLEX ANALYSIS

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

FOR FURTHER READING

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

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015.
3. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. 5Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.
6. T.Veerarajan, Engineering mathematics for First Year, Tata McGraw-Hill Publishing company Limited, New Delhi, 2014.

18EC102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements.
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

Articulation Matrix

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

UNIT I **6 Hours**

MECHANICS

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

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

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

UNIT IV **6 Hours**

LIGHT AND OPTICS

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

UNIT V **6 Hours**

MODERN PHYSICS

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

1 **5 Hours**

EXPERIMENT 1

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

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Meldes apparatus

7 **4 Hours**

EXPERIMENT 7

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

Total: 60 Hours

Reference(s)

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

18EC103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Summarize the unique properties of group IV elements and their applications in electronics
- Infer the purpose of alloying and the applications of alloys in electronic industries
- Outline the concept of nanomaterials and their application in electronics
- Deduce the importance of nanoelectronics and understand nanofabrication techniques
- Outline the concept of electrochemistry to protect materials from corrosion

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. Indicate the role of oxides of silicon and germanium for electronics applications
2. Apply the properties of ferrous and non-ferrous alloys in electronics industries
3. Outline the procedure of nanomaterial preparation, properties and their applications in electronics
4. Identify the role of nanofabrication techniques in nanoelectronics and analyze the morphology of materials using AFM, SEM and TEM techniques
5. Analyze the electrochemical reactions in metals and predict the suitable corrosion protection method

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	3	2												
4	2	1					1							
5	3						2							

UNIT I **6 Hours**

CHEMISTRY OF SEMI CONDUCTORS

Group IV elements - structure and properties - oxides of silicon and germanium - applications in electronics - IC device and VLSI design fabrication.

UNIT II **6 Hours**

ALLOYS

Purpose of alloying - properties and classification of alloys - ferrous and non-ferrous - silicon-germanium alloys-silicon and germanium-tin alloys - applications.

UNIT III **5 Hours**

NANOMATERIALS

Nanomaterials: Introduction - advantages over macromolecules - classification - general properties. Synthesis of nanomaterials and applications in electronics.

UNIT IV **6 Hours**

NANOELECTRONICS

Nanoelectronics - introduction - nanoelectronic architectures - nanofabrication - nanopatterning of metallic/semiconducting nanostructures, structural characterization (SEM, TEM and AFM).

UNIT V **7 Hours**

ELECTRO CHEMISTRY AND CORROSION CONTROL

Electrodes - cells - types and applications - electrochemical series. Corrosion - types - corrosion control methods - electroplating (copper) - electroless plating (nickel) - applications in PCB.

FURTHER READING

Impact of corrosion on electronic appliances. Applications of nanomaterials in electronics. Conducting polymers.

1 **3 Hours**

EXPERIMENT 1

Determination of silica content in given potassium silicate sample by titration method

2 **3 Hours**

EXPERIMENT 2

Determine the composition of copper present in the given brass alloy by EDTA method

3 **4 Hours**

EXPERIMENT 3

Synthesis of metal nanoparticles and their characterization

4 **4 Hours**

EXPERIMENT 4

Preparation of cadmium sulfide nano crystals using thiourea

5 **4 Hours**

EXPERIMENT 5

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

6 **3 Hours**

EXPERIMENT 6

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

7 **5 Hours**

EXPERIMENT 7

Electroplating of copper on a given target object and estimate the amount of copper corroded at anode

8 **4 Hours**

EXPERIMENT 8

Determination strength of mixture of acids (Hydrochloric acid and acetic acid) by conductometric titration

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012.
3. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
4. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, New Delhi, 2014.
5. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
6. Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007.

18EC104 COMPUTER PROGRAMMING I 2 0 2 3

Course Objectives

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

Programme Outcomes (POs)

a. 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.

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.

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. Design applications using functions and pointers in C.
5. Apply the concepts of structures and files in writing C programs.

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	1		3									
4	1	3			3									
5	1	3	3		3									

UNIT I **3 Hours**

INTRODUCTORY CONCEPTS

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

UNIT II **3 Hours**

CONTROL STATEMENTS

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

UNIT III **3 Hours**

ARRAYS AND STRINGS

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

UNIT IV **3 Hours**

FUNCTIONS AND POINTERS

User Defined Functions- Elements of user defined functions -categories of function - call by value and call by reference - recursion. Pointers - Accessing address of a variable -Declaring, Initializing and Accessing of pointer variables.

UNIT V **3 Hours**

STRUCTURES AND FILES

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

FOR FURTHER READING

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

1 **3 Hours**

EXPERIMENT 1

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

2 **4 Hours**

EXPERIMENT 2

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

3 **6 Hours**

EXPERIMENT 3

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

4 **4 Hours**

EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

5 **4 Hours**

EXPERIMENT 5

Implementation of nested if else Conditional Statement

6 **3 Hours**

EXPERIMENT 6

Implementation of Switch Case Statement.

7 **3 Hours**

EXPERIMENT 7

Implement a C program using for Looping Statement.

8 **3 Hours**

EXPERIMENT 8

Implement a C program using Do-While Looping Statement.

9 **3 Hours**

EXPERIMENT 9

Implement a C program using While Looping Statement.

10 **3 Hours**

EXPERIMENT 10

Implementation of Jumping Statements

11 **3 Hours**

EXPERIMENT 11

Implementation of One Dimensional Array.

12 **3 Hours**

EXPERIMENT 12

Implementation of Two Dimensional Array.

13 **3 Hours**

EXPERIMENT 13

Implement a C program to perform String Manipulation Functions.

14 **3 Hours**

EXPERIMENT 14

Implement a C program using structures and pointers

15 **3 Hours**

EXPERIMENT 15

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

Total: 60 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

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

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

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

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.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary exam level
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

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

UNIT I **9 Hours**

GRAMMAR

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

UNIT II **9 Hours**

READING

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

UNIT III **9 Hours**

WRITING

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

UNIT IV **9 Hours**

LISTENING

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

UNIT V **9 Hours**

SPEAKING

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

Total: 45 Hours

Reference(s)

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

18EC106 ENGINEERING GRAPHICS 1 0 4 3

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and vice versa.

Programme Outcomes (POs)

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

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. Illustrate the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines.
3. Draw the projection of planes and simple solids.
4. Draw the section of solids and development of surfaces.
5. Draw the orthographic projection from isometric view and vice versa.

Articulation Matrix

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

UNIT I **3 Hours**

FUNDAMENTALS OF ENGINEERING DRAWINGS

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

UNIT II **3 Hours**

PROJECTION OF POINTS

Principles of projection, projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

UNIT III **3 Hours**

PROJECTION OF PLANES AND SOLIDS

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

UNIT IV **3 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids - simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids.

UNIT V **3 Hours**

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

Orthographic projections and isometric view of components used in engineering applications.

1 **12 Hours**

EXPERIMENT 1

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

2 **12 Hours**

EXPERIMENT 2

Create part model of a component from given isometric drawings.

3 **12 Hours**

EXPERIMENT 3

Create part model of a component from given orthographic views.

4 **12 Hours**

EXPERIMENT 4

Create an assembly model of product from detailed parts drawing.

5 **12 Hours**

EXPERIMENT 5

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

Total: 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
4. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
5. Chua Chee Kai, Leong Kah Fai, Rapid Prototyping: Principles & Applications, World Scientific, 2003.
6. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010

18EC201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.

- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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 various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

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

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

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

UNIT II **9 Hours**

MULTIPLE INTEGRALS

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

UNIT III **9 Hours**

SEQUENCES AND SERIES

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

UNIT IV **9 Hours**

MAPPING OF COMPLEX FUNCTIONS

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

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

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

FOR FURTHER READING

Applications in Electromagnetic Fields,Applications in Communication Theory.

Total: 60 Hours

Reference(s)

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

18EC202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

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

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Identify the seven types of crystal systems, crystal planes and illustrate unit cell characteristics of SC, BCC, FCC and HCP crystal structures.
2. Exemplify the characteristics of semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams.

3. Differentiate the active and passive components in an electronic circuit and outline the working mechanisms of diodes.
4. Analyse the properties of magnetic materials, domain theory of ferromagnetism and the applications of recording and readout process.
5. Outline the interaction of electromagnetic radiation with matter and working principle of LED, LCD and OLED display devices

Articulation Matrix

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

UNIT I **6 Hours**

CRYSTAL PHYSICS

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

UNIT II **7 Hours**

SEMICONDUCTING MATERIALS

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

UNIT III **5 Hours**

PASSIVE AND ACTIVE COMPONENTS

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

UNIT IV **6 Hours**

MAGNETIC MATERIALS

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

UNIT V **6 Hours**

DISPLAY DEVICES

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

1 **5 Hours**

EXPERIMENT 1

Measurement of resistivity of a given material by four probe method

2 **5 Hours**

EXPERIMENT 2

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

3 **5 Hours**

EXPERIMENT 3

Determine the V-I characteristics of a solar cell

4 **5 Hours**

EXPERIMENT 4

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

5 **5 Hours**

EXPERIMENT 5

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

6 **5 Hours**

EXPERIMENT 6

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

Total: 60 Hours

Reference(s)

1. Balasubramaniam, R. "Callister"s Materials Science and Engineering"". Wiley India Pvt.Ltd., 2014
2. Kasap, S.O., Principles of Electronic Materials and Devices, McGraw-Hill Education,2017
3. William D. Callister, Jr. & David G. Rethwisch, Fundamentals of Materials Science and Engineering, John Wiley and Sons Incl.,2008
4. Wahab, M.A., Solid State Physics: Structure and Properties of Materials, Alpha Science International Ltd., 2017
5. Donald A. Neamen. "Semiconductor Physics and Devices", Mc Graw-Hill, 2011
6. 6.Palanisamy P. K. "Physics for electronics and information science" Dipti Press Pvt. Ltd., 2018. 7. Papadopoulos, Christo, "Solid-State Electronic Devices An Introduction", Springer, NewYork, 2014. 8. Raghavan, V. "Materials Science and Engineering: A First course". PHI Learning, 2015. 9. B.L.Theraja, "Basic Electronics Solid State", S.Chand& Company Ltd, New Delhi, 2000.

18EC203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Summarise the basics of polymer and its applications in electronics
- Infer the working principle of optoelectronic materials and their applications
- Interpret the application of ceramic insulating materials in electronics
- Introduce the concept of spectroscopy and analyze the interaction of electromagnetic radiations with matter
- Outline the basics of nuclear magnetic radiation techniques and their instrumentation

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. Analyze the physical, chemical and morphological properties of polymer materials used in various applications
2. Apply the basic concepts of optoelectronic materials to develop the electronic materials used in day-to-day life
3. Identify the properties and various applications of ceramic materials in various fields
4. Select the suitable electromagnetic radiation and analytical method for the identification of target compounds
5. Indicate the applications of NMR, ESR spectroscopy and diffractometer

Articulation Matrix

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

UNIT I **6 Hours**

ELECTRONIC POLYMERS

Polymer - introduction - physical, chemical and morphological properties of electronic polymers and their applications - piezo and pyroelectric polymers. Polymers in optical media - data storage devices.

UNIT II **6 Hours**

CHEMISTRY FOR OPTOELECTRONICS

Semiconducting materials - types. LED - types - working - advantages. Photovoltaics and organic solar cells - principle - working and applications.

UNIT III **6 Hours**

ELECTRONIC CERAMICS

Properties of ceramic insulators - ceramic capacitor materials - ferrite (magnetic) ceramics - ceramic sensors. Application and characterization of ZnO varistors. Resistor materials: Carbon based materials and metal based materials.

UNIT IV **6 Hours**

SPECTROSCOPY

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

UNIT V **6 Hours**

MAGNETIC AND RADIATION TECHNIQUES

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

FURTHER READING

Energy storage devices - conventional batteries and modern batteries.

1 **4 Hours**

EXPERIMENT 1

Determination of molecular weight of given polymer by Ostwald Viscometer

2 **4 Hours**

EXPERIMENT 2

Identification of polymer compounds using IR spectroscopy

3 **4 Hours**

EXPERIMENT 3

Preparation of conducting polymer by electrodeposition method

4 **3 Hours**

EXPERIMENT 4

Interpretation of DTA curve analysis of ceramic materials

5 **4 Hours**

EXPERIMENT 5

Estimation of Zn in ceramics using EDTA method

6 **4 Hours**

EXPERIMENT 6

Determination of strength in the given dye solution by the spectrophotometric method

7 **4 Hours**

EXPERIMENT 7

Determination of iron (thiocyanate method) in the given solution by UV-Visible radiation

8 **3 Hours**

EXPERIMENT 8

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

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
3. Hobart H. Willard, Lynne L. Merritt Jr., John A. Dean, Frank A. Settle Jr., Instrumental method of analysis, 7th Edition, CBS Publisher & Distributors Pvt. Ltd., New Delhi, 2013.
4. William Kemp, Organic spectroscopy, 3rd Edition, Macmillan Publisher, 2010
5. S. B. Lang and S. Muensit, Review of some lesser - known applications of piezoelectric and pyroelectric polymers, Appl. Phys. A 85, 125 - 134 (2006)

18EC204 CIRCUIT ANALYSIS 3 1 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 two port networks and analysis different types of two port network.

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.
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.
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. Apply Voltage-Current laws and transformation techniques to solve linear electric circuits and analyze the phase relationships of circuits with RLC components
2. Determine the electrical parameters of the circuits by using network theorems
3. Analyze the steady state and transient response of RLC circuit using Laplace transform
4. Analyze the frequency response of an electric circuit.

5. Determine driving point and transfer function of two port network and classify different two port network.

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 **10 Hours**

CIRCUIT LAWS AND ANALYSIS TECHNIQUES

Basic electrical components, Voltage - current laws, Divider theorem, Short and Open Circuits,Phase relationship for R, L and C, Impedance and Admittance for R, L and C, Mesh and Nodal Analysis for AC and DC circuits, Source transformation techniques, Star delta transformation techniques.

UNIT II **9 Hours**

NETWORK THEOREMS FOR DC AND AC CIRCUITS

Superposition theorem - Thevenin"s theorem - Norton"s theorem - Maximum power transfer theorem - Reciprocity theorem.

UNIT III **8 Hours**

STEADY STATE AND TRANSIENT ANALYSIS OF AC AND DC CIRCUITS

Steady state and Transient analysis of RL, RC, RLC circuits using Laplace Transform for both AC and DC input.

UNIT IV **9 Hours**

RESONANCE AND MAGNETICALLY COUPLED CIRCUITS

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

UNIT V **9 Hours**

LINEAR TWO PORT NETWORK PARAMETERS

Driving point and transfer function of two port network, Z, Y, T, inverse T, Hybrid, Inverse Hybrid Parameters and its conversion.

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: 60 Hours

Reference(s)

1. William Hayt, JVJack, EKemmerly and Steven M Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.
2. Joseph Edminister and Mahmood Nahri, 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

18EC206 ANALOG ELECTRONICS I 3 0 0 3

Course Objectives

- To Analyze the modelling, characteristics and electrical parameters of Diode, BJT and MOSFET
- To illustrate the applications of Diode in designing rectifier and wave shaping circuits
- To illustrate the applications of BJT and MOSFET in designing electronic switch and amplifier

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.
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. Analyze the characteristics and operation of a ideal and practical diode
2. Apply the concepts of diode operation to design rectifier circuits and wave shaping circuits
3. Apply the concepts of BJT operation to design electronic switch and amplifier
4. Analyze the modelling and characteristics of MOSFET
5. Apply the concepts of MOSFET operation to design electronic switch and amplifier

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

UNIT I **9 Hours**

THEORY OF PN JUNCTION

Factors affecting the conductivity of intrinsic and extrinsic semiconductors, Drift and Diffusion of charge of charge carriers in semiconductors, Static characteristics of ideal and practical diode, Junction Capacitance, Zener and Avalanche breakdown.

UNIT II **9 Hours**

APPLICATIONS OF PN JUNCTION DIODE

Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Power Supply Design, Zener Diode based voltage regulator, Clipper, Clamper.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

Characteristics and Operation of NPN and PNP Transistor - Transistor Configuration: CB, CE, CC, BJT as a Switch and Amplifier - DC and AC Operating Point - Transistor Biasing: Fixed Bias, Emitter Bias, Collector Feedback Bias, Voltage Divider Bias.

UNIT IV **10 Hours**

MOSFET MODELLING

Operation of JFET - Construction and Operation of Enhancement and Depletion type MOSFET, Expression of Drain Current Equation of MOSFET (Linear, Saturation and Cut-off), Transconductance, Input Impedance, Channel Length Modulation and its effect in MOSFET, Small Signal Model of MOSFET, Internal Capacitance of MOSFET.

UNIT V **8 Hours**

APPLICATIONS OF MOSFET

Biasing of MOSFET - MOSFET as an Amplifier and Switch, Common Source and Common Drain Configuration, Power MOSFET.

FOR FURTHER READING

Voltage Multiplier using Diode - Transistor Categories and Packaging - Emitter Feedback bias

Total: 45 Hours

Reference(s)

1. Thomas L. Floyd ,Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.

3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018).

18EC207 COMPUTER PROGRAMMING II 2 0 2 3

Course Objectives

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

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.
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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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. Implement C++ programs using operators, type conversion and input-output functions.
2. Develop C++ programs using the concepts of Arrays and Functions.
3. Apply the concepts of classes and objects in writing C++ programs.
4. Design applications using inheritance in C++.
5. Apply the concepts of pointers and polymorphism in writing C++ programs.

Articulation Matrix

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

UNIT I **3 Hours**

INTRODUCTION TO OOP AND C BASICS

Procedural vs. Object Oriented Programming, Overview of C++, Program structure, Exploring the basic components of C++, Type casting in C++, Preprocessor Directives, Operators in C++, Namespace, Control Structures.

UNIT II **3 Hours**

ARRAYS AND FUNCTIONS

Introduction to Arrays, Multidimensional Arrays, Strings, String related Library Functions, Explore functions, Inline Functions, Overloading of Functions and Operators, Recursive Functions.

UNIT III **3 Hours**

CLASSES AND OBJECTS

Basics of Object and class in C++, Constructor and their types, Destructors, Friend classes and Functions, Passing Objects as Function parameters, Returning objects from functions.

UNIT IV **3 Hours**

INHERITANCE

Concept of Inheritance, Access specifier, Base and derived class constructors, Types of inheritance, Overriding, Virtual functions, Destructor overriding.

UNIT V **3 Hours**

POINTERS AND POLYMORPHISM

Pointers in C++, Pointers and Objects, Dynamic Memory Management using Operators, This Pointer, Polymorphism, Pure Virtual functions, Virtual Base class, Abstract classes.

FOR FURTHER READING

Concept of streams, The cin and cout objects, C++ stream classes, Unformatted I/O, Formatted I/O, Manipulators, Stream error states, File stream, C++ file Stream classes, File management functions, Command line arguments, Class templates, Exception Handling.

1 **10 Hours**

EXPERIMENT 1

Implementation of operator overloading with class and objects.

1. Write a C plus plus program to find the square and cube of a number using class and object.
2. Write a C plus plus program to find the area of rectangle and circle using class and object.
3. Write a C plus plus program to find whether the given number is an Armstrong number using classes and objects.

2 **10 Hours**

EXPERIMENT 2

Implementation of types of Inheritance.

1. Write a C plus plus program to generate employee payroll using inheritance.
2. Write a C plus plus program to student details using multilevel inheritances.
3. Write a C plus plus program to employee details using multiple inheritance.

3 **10 Hours**

EXPERIMENT 3

Implementation of two different classes for adding a private data member using friend function.
1. Write a C plus plus program to multiply two matrices using static member function with friend function.
2. Write a C plus plus program to perform complex number subtraction by overloading an operator using friend function.
3. Write a C plus plus program to perform arithmetic operations using friend function

4 **15 Hours**

EXPERIMENT 4

Implementation of operator and function overloading.
1. Write a C plus plus program to perform conversion from integer to complex number by operator overloading.
2. Write a C plus plus program to perform from complex number to integer using operator overloading.
3. Write a C plus plus program to perform addition of two numbers using function overloading.

Total: 60 Hours

Reference(s)

1. E.Balagurusamy,Object Oriented Programming with C++, Tata McGraw Hill Publishing, New Delhi, 2011.
2. Robert Lafore, Object Oriented Programming in C++, Galgotia Publication, 2010.
3. B. Trivedi,Programming with ANSI C++, Oxford University Press,2010.
4. H.M Deitel and P.J Deitel,C++ How to Program, Seventh Edition, Prentice Hall, 2010.
5. Herbert Schildt, C++: The Complete Reference, Fourth Edition, Tata McGraw-Hill, 2010.
6. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing, New Delhi, 2010.

18EC208 BASIC ELECTRONICS LABORATORY 0 0 2 1

Course Objectives

- To analyze the laws and theorems in electrical circuits
- To design electronics circuits using Diodes and Transistors

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.
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. Analyze the Current- Voltage Laws and Circuit Theorems
2. Design Diode based Electronic circuits
3. Apply the operation of BJT for switching and Amplification applications
4. Apply the operation of MOSFET for switching and Amplification applications

Articulation Matrix

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

1 **4 Hours**

EXPERIMENT 1

Verification of Current and Voltage Laws (Ohms Law, KVL, KCL)

2 **4 Hours**

EXPERIMENT 2

Verification of Circuit Theorems (Mesh, Node, Superposition)

3 **2 Hours**

EXPERIMENT 3

Design of Half wave and Full wave rectifiers

4 **4 Hours**

EXPERIMENT 4

Design of power supply unit for electronic gadgets

5 **4 Hours**

EXPERIMENT 5

Design of wave shaping circuits

6 **4 Hours**

EXPERIMENT 6

Application of BJT as a switch and an amplifier

7 **4 Hours**

EXPERIMENT 7

Application of MOSFET as a switch and an amplifier

8 **4 Hours**

EXPERIMENT 8

Design of H Bridge motor driver using MOSFET

Total: 30 Hours

Reference(s)

1. Thomas L. Floyd ,Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007
3. William Hayt, J V Jack, E Kemmerly and Steven M Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.

18EC301 ENGINEERING MATHEMATICS III 3 1 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.
- 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, 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 a partial differential equation and able to solve them.
2. Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series and Formulate a function in frequency domain whenever the function is defined in time domain.
3. Formulate a function in frequency domain whenever the function is defined in time domain.
4. Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.
5. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.

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												
4	1	2												
5	-	2												

UNIT I **11 Hours**

PARTIAL DIFFERENTIAL EQUATIONS

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

UNIT II **10 Hours**

FOURIER ANALYSIS

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

UNIT III **9 Hours**

LAPLACE TRANSFORMS

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

UNIT IV **8 Hours**

Z TRANSFORM

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

UNIT V **7 Hours**

MATHEMATICAL STATISTICS

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

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
3. O Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.

18EC302 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- Understand the basic concepts of power generation and transmission.
- Illustrate the construction and operation of DC machines.
- Illustrate the construction and operation of AC machines
- Illustrate the construction and operation of special machines
- Understand the various components used in electrical installations.

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.
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. Explain the basic concepts of electric power generation and transmission.
2. Explain the operating principle of DC shunt and series motor
3. Classify static and dynamic machines and explain their operation.
4. Analyze the operation of special electrical machines
5. Analyze the functions of various components used in electrical installation systems.

Articulation Matrix

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

UNIT I **7 Hours**

POWER GENERATION AND TRANSMISSION

Main parts and working of a Thermal power station, Hydro power station, Single line diagram of power transmission and distribution system- Skin and proximity effects- Hollow conductors- Bundled conductor.

UNIT II **6 Hours**

DC MACHINES

Basic concepts of magnetic circuits, Faradays law, Lenz law, Construction and operation of DC shunt and series motor, characteristics and applications.

UNIT III **7 Hours**

AC MACHINES

Construction and principle of operation: Transformer, Alternator, Three phase induction motor, Single phase induction motors, Star-Delta starter for three-phase induction motor.

UNIT IV **5 Hours**

SPECIAL MACHINES

Construction and principle of operation: Stepper motor, Servomotor, Permanent magnet DC motor, Brushless DC motor.

UNIT V **5 Hours**

ELECTRICAL INSTALLATIONS

Types of Protection devices: Fuses, MCB, Relays, Components of House Wiring, Simple house wiring and stair case wiring, UPS, Earthing and grounding.

FOR FURTHER READING

High voltage DC transmission, Braking of DC motor, Induction generator, Universal motor, Earth leakage circuit breaker.

1 **6 Hours**

EXPERIMENT 1

Analysis of generating capacity of different types of power plants.

2 **6 Hours**

EXPERIMENT 2

Prototype Development of DC motor and measuring of voltage and speed.

3 **6 Hours**

EXPERIMENT 3

Dismantling and assembling of ceiling fan and Grinder.

4 **6 Hours**

EXPERIMENT 4

Controlling the speed of Stepper Motor and Servo Motor

5 **6 Hours**

EXPERIMENT 5

Developing model of simple house wiring and Stair Case Wiring

Total: 60 Hours

Reference(s)

1. C.L .Wadhwa, Electrical Power Systems, New Age International Edition, New Delhi 2010.

2. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
3. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2012
4. B. L. Theraja, A. K. Theraja, A Text Book of Electrical Technology Volume II, S.Chand &Company Ltd, New Delhi, 2016.
5. V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 2014

18EC303 DIGITAL LOGIC CIRCUIT DESIGN 3 1 0 4

Course Objectives

- To acquire the basic knowledge of digital logic levels and applications to understand digital electronic circuits
- To perform the analysis and design of various digital electronic circuits
- To develop the ability to test the digital circuits

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.
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. Infer the fundamental concepts of digital electronics and correct the error during data transmission.
2. Analyze boolean laws and techniques for minimization of logic circuits.
3. Design and analyze the combinational logic circuits along with its applications.
4. Design and analyze sequential logic circuits along with its applications.
5. Design and analyze synchronous & asynchronous logic circuits and also Realize them without hazards.

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

UNIT I **8 Hours**

NUMBER SYSTEMS AND CODE

Introduction to Digital Systems, Number Systems- Binary, Octal, Decimal and Hexadecimal, Methods of base conversions, Representation of signed numbers; Fixed and floating point numbers, Binary Arithmetic - Addition, Subtraction, Complementary numbering systems: 1s and 2s Complements, Codes- Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming code

UNIT II **9 Hours**

BOOLEAN THEOREMS AND LOGIC REDUCTION

Basic Theorems and Properties Of Boolean Algebra, Boolean Functions, Canonical and Standard Forms- Sum of Products Form, Product of Sum Form, Gate level minimization - Karnaugh-Map Method, Logic expression simplification with grouping cells: Quine McClusky Method (Upto 4 variable); Prime implicants, Prime implicant chart, NAND And NOR Implementation.

UNIT III **9 Hours**

COMBINATIONAL LOGIC CIRCUIT AND DESIGN

Binary adders- Half adder, Full adder, Binary Subtractor-Half subtractor, Full subtractor, Parallel Binary Adders, BCD Adders, Encoder, Decoder, Comparator, Code convertor, Multiplexers, Demultiplexers, Parity Generator and Checker

UNIT IV **10 Hours**

SEQUENTIAL LOGIC CIRCUITS

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flip Flop Conversion. Shift registers, General model of sequential circuits- Mealy/Moore models -Excitation table- State table- State diagram

UNIT V **9 Hours**

DESIGN OF SEQUENTIAL LOGIC

Design of Asynchronous & Synchronous sequential circuits - Binary Counter, Ring counters, Johnson counters, Up/Down counter, Asynchronous counter- Hazards logic circuits- Hazard free realization. Logic Families-RTL, DTL, ECL, TTL, CMOS

Total: 60 Hours

Reference(s)

1. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015

3. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016

18EC304 ANALOG ELECTRONICS II 3 1 0 4

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, 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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 **8 Hours**

TRANSISTOR BIASING

BJT:Bias Stability,Bias Compensation- Thermistor and Sensistor and Diode compensation-Thermal Runaway,Mobility and Lifetime of electrons and holes in BJT,FET: Biasing by Fixing VGS, Biasing by connecting Resistance, Biasing by Drain to Gate Feedback Resistor, and Biasing using Constant Current Source.

UNIT II **9 Hours**

SMALL SIGNAL LOW FREQUENCY MODEL AND CURRENT MIRROR STAGE

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 **9 Hours**

SMALL SIGNAL HIGH FREQUENCY MODELS AND DIFFERENTIAL PAIR

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 **10 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: 60 Hours

Reference(s)

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory an Applications ,7th Edition, Oxford University, 2017.
2. Jacob Millman, C. Halkias and Satyabrata Jit Electronic Devices and Circuits, 4TH Edition, Tata McGraw-Hill, 2015
3. Electronic Circuits Analysis and design, Donald A Neaman, 7th Edition
4. Muhammad H. Rashid , Microelectronic Circuits: Analysis and Design, 3rd Edition, Cengage Learning
5. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 5th edition

18EC305 LINEAR INTEGRATED CIRCUITS 3 0 0 3

Course Objectives

- Understand the classification of IC and basic building blocks of analog integrated circuits.
- Design and analyse the linear and non-linear applications of operational amplifiers.
- Illustrate the operating principle of PLL, Data Converters and various special function ICs.

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.
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 broadest 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. Analyze the internal structure of operational amplifiers and its characteristics.
2. Characterize and analyze the applications of operational amplifiers.
3. Design comparator and waveform generators 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 **9 Hours**

OPERATIONAL AMPLIFIER

Introduction to Integrated Circuits- Classification of ICs - Operational Amplifier: Basic Information of Op-Amp, Ideal Op Amp- Operational Amplifier Internal Circuit- Differential Amplifier - Characteristics of Op-Amp - DC Characteristics, AC Characteristics - Frequency Response- Frequency Compensation - Slew Rate.

UNIT II **9 Hours**

OP- AMP 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-log and antilog amplifiers- 1st Order LPF, HPF and all pass filters.

UNIT III **9 Hours**

COMPARATORS 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 Sine wave Oscillator- RC Phase Shift, Wien Bridge Oscillator.

UNIT IV **10 Hours**

PHASE LOCKED LOOP AND DATA CONVERTER

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

UNIT V **8 Hours**

SPECIALIZED ICS

IC 555 Timer Internal Architecture- Astable and Monostable Multivibrators using 555 Timer -Applications- Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply - Switch Mode Power Supply - Single power supply for opAmp.

Total: 45 Hours

Reference(s)

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, McGraw-Hill, 2002.
2. Ramakant A.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2002.

3. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
4. William D.Stanely, Operational Amplifiers with Linear Integrated Circuits. Pearson Education, 2004.
5. David L.Terrell,Op Amps-Design, Application, and Troubleshooting, Elsevier publications 2005.
6. Taub and Schilling, Digital Integrated Electronics, McGraw-Hill, 1997.

18EC306 DATA STRUCTURES AND ALGORITHMS 2 0 2 3

Course Objectives

- Understand the basics of datastructures
- Gain knowledge about the implementation of datastructures.
- Impart knowledge about techniques for analyzing the efficiency of algorithms

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.
n. 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 model of Abstract Data Type, calculation of algorithm efficiency and designing of recursive algorithms.
2. Design algorithms to solve real life problems using data structures.
3. Analyze various sorting and searching algorithms.
4. Recognise the usage of Non-Linear Data structures such as Binary Search tree, AVL search tree and Heap tree in applications.
5. Solve real life problems using minimum spanning tree and shortest path algorithms.

Articulation Matrix

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

LINEAR DATASTRUCTURES

Stack-Queue-List-Application of Stack, Queue, List.

UNIT III **6 Hours**

SORTING AND SEARCHING

Insertion, Selection, Bubble, Quick, Heap sorting algorithms, Sequential search, Binary Search, Hashing, Hash function, Separate Chaining, Open Addressing, Linear Probing.

UNIT IV **6 Hours**

NON LINEAR DATASTRUCTURES

Trees, Binary Trees, Binary Tree Traversal, Expression Tree, AVL Tree, Priority Queue.

UNIT V **6 Hours**

GRAPHS

Graph Representation, Adjacency matrix, Adjacency List, Depth Fist Traversal, Breath First Traversal, Kruskal, Prims, Dijkstra Algorithm.

1 **2 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

Linked List Implementation of stack and queue.

3 **2 Hours**

EXPERIMENT 3

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

4 **2 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 quick, heap sort.

6 **2 Hours**

EXPERIMENT 6

Develop a program to perform linear and binary search.

7 **2 Hours**

EXPERIMENT 7

Implementation of binary tree traversals.

8 **2 Hours**

EXPERIMENT 8

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

9 **2 Hours**

EXPERIMENT 9

Implementation of breadth first search and depth first search techniques.

10 **2 Hours**

EXPERIMENT 10

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

11 **2 Hours**

EXPERIMENT 11

Design a Palindrome Checker using Dequeue.

12 **2 Hours**

EXPERIMENT 12

Implementation Text Editor using two stacks.

13 **2 Hours**

EXPERIMENT 13

Implementation of Expression Tree.

14 **2 Hours**

EXPERIMENT 14

Implementation of Media Player Playlist using List.

15 **2 Hours**

EXPERIMENT 15

Implementation of Binary Tree Traversal.

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.

18EC307 ANALOG ELECTRONICS AND IC 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, 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.
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.
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. Design and analyze the performance of Power amplifiers
2. Design an Oscillator for the given specifications.
3. Analyze 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		3										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 **3 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 **4 Hours**

EXPERIMENT 7

Design of Inverting and Non-inverting Amplifiers, Voltage Follower, Differentiator and Integrator.

8 **2 Hours**

EXPERIMENT 8

Zero crossing detector and Schmitt trigger using IC741.

9 **3 Hours**

EXPERIMENT 9

Design of butterworth active LPF and HPF.

10 **2 Hours**

EXPERIMENT 10

Astable and Monostable Multivibrator using IC 555.

11 **3 Hours**

EXPERIMENT 11

RC-phase shift oscillator and Wien bridge oscillator using IC741.

12 **3 Hours**

EXPERIMENT 12

Analog to Digital converter and Digital to Analog Converter.

Total: 30 Hours

Reference(s)

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory and Applications ,7th Edition, Oxford University, 2017.
2. Jacob Millman, C. Halkias and Satyabrata Jit Electronic Devices and Circuits, 4TH Edition, Tata McGraw-Hill, 2015
3. Electronic Circuits Analysis and design, Donald A Neaman, 7th Edition
4. RamakantA.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2002.
5. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
6. Sergio Franco, Design with operational amplifiers and analog integrated circuits, McGraw-Hill, 2002.

18EC308 DIGITAL ELECTRONICS LABORATORY 0 0 2 1

Course Objectives

- To learn and understand the basics of digital circuits using logic gates.
- To design a various types of combinational digital logic circuits.
- To design a various types of sequential digital logic circuits.

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.
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. 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. Implementation of boolean expressions using universal gates.
2. Design various types of combinational circuits using logic gates.
3. Conversion of Flip-flops in the design of sequential circuit using logic gates.
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		3		2	
2	2	2	3	1							3		2	
3	1	1	2	3					2				2	
4	1	1	3	2					2				2	
5	1	1	3	2					2				2	

1 **3 Hours**

EXPERIMENT 1

Design and implementation of Boolean logic functions using universal gates.

2 **3 Hours**

EXPERIMENT 2

Implementation of binary adder and subtractor using logic gates.

3 **2 Hours**

EXPERIMENT 3

Design and implementation of encoder and decoder using logic gates.

4 **2 Hours**

EXPERIMENT 4

Design and implementation of multiplexer and demultiplexer logic gates.

5 **3 Hours**

EXPERIMENT 5

Design and implementation of standard boolean function using data selector and data decoder.

6 **2 Hours**

EXPERIMENT 6

Design and implementation of 2 bit magnitude comparator using logic gates.

7 **3 Hours**

EXPERIMENT 7

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

8 **3 Hours**

EXPERIMENT 8

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

9 **3 Hours**

EXPERIMENT 9

Conversion of flip-flops.

10 **3 Hours**

EXPERIMENT 10

Design and implementation of Shift register (SISO, SIPO,PIPO) using Flip flops.

11 **3 Hours**

EXPERIMENT 11

Design and implementation of Up, Down and Up/down counter using flip flops.

Total: 30 Hours

Reference(s)

1. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015
3. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016
4. Ronald J Tocci, Neal S Widmer,Gregory L Moss Digital Systems: Principles and Applications, 10th edition, Person , 2009.
5. Tokheim Digital Electronics: Principles and Applications, 7th edition Tata McGraw-Hill, 2010.

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

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

Programme Outcomes (POs)

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

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **15 Hours**

INTRODUCTION

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

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

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

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

18EC401 PROBABILITY AND RANDOM PROCESS 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables.
- Summarize and apply the methodologies of probability for the data analysis using statistical notions.
- It provides insight into the classifications of random processes

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. 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 Random Process techniques the problem of random input signals.
5. Analyze the response of random inputs to linear time invariant systems.

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLES

Axioms of probability, Conditional probability, Total probability, Bayes theorem, Random variables, Probability mass function, Probability density functions, Properties, Moments, Moment generating functions and their properties.

UNIT II **9 Hours**

STANDARD DISTRIBUTIONS

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions and their properties. Functions of a random variable.

UNIT III **9 Hours**

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and regression - Transformation of random variables - Central limit theorem(without proof).

UNIT IV **9 Hours**

CLASSIFICATION OF RANDOM PROCESSES

Definition and examples - first order, second order, strictly stationary, wide sense stationary and Ergodic processes - Markov process - Poisson and Normal processes - Sine wave process.

UNIT V **9 Hours**

CORRELATION AND SPECTRAL DENSITIES

Auto correlation - Cross correlation - Properties - Power spectral density - Cross spectral density - Properties - Wiener-Khintchine relation - Relationship between cross power spectrum and cross correlation function - Linear time invariant system - System transfer function - Linear systems with random inputs - Auto correlation and cross correlation functions of input and output.

Total: 60 Hours

Reference(s)

1. T. Veerarajan. , Probabilitiy, Statistics and Random process , Tata McGraw Hill Publications, New Delhi, 2003
2. JR . Peyton. Z. Peebles, Probability, Random Variables and Random Signal Principles, Tata McGraw Hill Publications, New Delhi, 2002.
3. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
4. Henry Stark and John W. Woods , Probability and Random Processes with Applications to Signal Processing , Pearson Education, Delhi, 2002..
5. Athanasios Papoulis, S. UnniKrishna Pillai, Probability , Random Variables and Stochastic Processes, Tata McGraw Hill Publications, New Delhi, 2002.

18EC402 SIGNALS AND SYSTEMS 3 1 0 4

Course Objectives

- Understand the Mathematical Representation of Signals and Systems
- Explain the concept of Linear Time Invariant Systems and the Convolution property
- Represent a given Continuous Time signal in frequency domain using fourier Series and Fourier Transform
- Represent a given Discrete Time signal in frequency domain using fourier Series and Fourier Transform
- Understand Spectrum Analysis of Continuous Time signals and sampled version of the CT signal

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.
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. Classify a given signal or a system by analyzing the mathematical representation.
2. Apply the concept of Convolution to predict the behaviour of a given Linear Time Invariant System

3. Analyze the frequency domain behaviour of a given Continuous Time signal using Fourier Analysis and Laplace Analysis
4. Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Time Fourier Analysis and Z Transform Analysis
5. Analyze the Spectrum of Continuous Time Signals and its sampled versions.

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

UNIT I **10 Hours**

INTRODUCTION TO SIGNALS AND SYSTEMS

Introduction to Signals and Systems, Classification of Signals based on Independent Variable, Elementary Signals, Amplitude and Time Operation on Signals, Types of Systems, Properties of Systems

UNIT II **8 Hours**

ANALYSIS OF LINEAR TIME INVARIANT SYSTEMS

Concept of Impulse Response, Convolution Integral and Convolution Sum, Causality and Stability of LTI Systems, Interconnection of LTI Systems, Correlation of Signals, Orthogonality of Signals

UNIT III **9 Hours**

FREQUENCY DOMAIN REPRESENTATION OF CT SIGNALS

Fourier Series, Properties of CTFS, Fourier Transform, Properties of CTFT, Gibbs Phenomena, Dirichlet Conditions, Laplace Transforms, Properties of Laplace Transforms

UNIT IV **9 Hours**

FREQUENCY DOMAIN REPRESENTATION OF DT SIGNALS

Discrete Time Fourier Series, Properties of DTFS, Discrete Time Fourier Transform, Properties of DTFT, Z Transform, Properties of Z Transforms

UNIT V **9 Hours**

SPECTRUM ANALYSIS OF LTI SYSTEMS

Spectrum Analysis of Continuous-Time Systems, Spectrum Analysis of Discrete-Time Systems, Sampling Theorem with Proof

Total: 60 Hours

Reference(s)

1. Signals and Systems, Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, 2nd Edition, Pearson, 2013
2. Signals and Systems, Simon Haykin, Barry Van Veen, 2nd Edition, John Wiley & Sons, 2007
3. Principles of Linear Systems and Signals, B. P. Lathi, 2nd Edition, Oxford University Press, 2009

4. Signals, Systems, Transforms, and Digital Signal Processing with MATLAB, Michael Corithios, CRC Press. 2018
5. Signals and Systems, Tarun Kumar Rawat, Oxford University Press, 2010

18EC403 ANALOG COMMUNICATION 3 0 0 3

Course Objectives

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

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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 mathematical model for generation and detection of different AM systems based on time domain representation and its spectrum
2. Design of FM Transmission & Reception system and analyze with its mathematical model.
3. Analyze the effect of noise on communication receivers.
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	
2	2	3		1			1							2
3	2	1	2	2										3
4	1	2		1				2					2	
5	1	2	2	1									2	2

UNIT I **10 Hours**

AMPLITUDE MODULATION

Introduction to communication system, Need for modulation, Introduction to Amplitude Modulation, Generation of AM wave, Double sideband suppressed carrier modulation (DSBSC),Generation of DSB-SC waves, Detection of DSB-SC Modulated waves, Generation of Single Side Band (SSB),Demodulation of SSB Waves, Generation of Vestigial Sideband (VSB) Modulated wave, Comparison of AM Techniques, Applications of different AM Systems, AM transmitter and receiver.

UNIT II **9 Hours**

ANGLE MODULATION

Theory of Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, wide band FM, Transmission bandwidth of FM waves, Generation of FM waves: Direct FM Methods, Indirect FM, Methods; The Armstrong Method, FM Stereo Transmission and Demodulation of FM waves: FM stereo multiplexing, Phase- locked loop. Comparison of FM and AM Phase, Modulation - Comparison of AM FM and PM.

UNIT III **9 Hours**

RANDOM VARIABLE AND RANDOM PROCESS FOR COMMUNICATION SYSTEMS

Review of random process, Response of LTI systems to random process, Gaussian random process: Filtered Gaussian random process, White Guassian Noise, Noise: Sources of noise, thermal noise, shot noise and flicker noise. Filtered White noise, Narrow Band Noise, Noise Figure, Noise Bandwidth, Noise Temperature.

UNIT IV **8 Hours**

NOISE IN COMMUNICATION SYSTEMS

Noise in AM receivers, Noise in DSB-SC receiver, Noise in SSB receiver, Noise in FM receivers,Pre-emphasis and de-emphasis in FM, Comparison of noise performance of AM and FM systems

UNIT V **9 Hours**

PULSE MODULATION

Sampling process: sampling theorem for band limited signals, ideal and practical sampling, Anti aliasing and reconstruction filters, Generation and detection of Pulse Amplitude Modulation (PAM), Generation and detection of Pulse Width Modulation (PWM), Generation and detection of Pulse Position Modulation (PPM), Generation and detection of Pulse Time Modulation (PTM), Time division Multiplexing, Crosstalk effect.

FUTURE READING
communication system design

Total: 45 Hours

Text Book(s)
1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition,2016.
2. Analog and Digital Communication - K. Sam Shanmugam, Wiley, 2005.

Reference(s)
1. Communication Systems- B.P. Lathi, BS Publication, 2004.
2. Principles of Communication Systems - H Taub & D. Schilling, Gautam Sahe, TMH, 2007, 3rd Edition
3. Electronic Communications- Dennis Roddy and John Coolean , 4th Edition , PEA, 2004
4. Electronics Communication systems,Wayne Tomasi,4th edition, Pearson Publishers.

18EC404 PRINCIPLES OF VLSI DESIGN 3 0 0 3

Course Objectives
- To acquire the basic knowledge about CMOS fabrication process
- To understand the operating principle of CMOS circuit design and styles to represent VLSI circuits
- To understand the design of VLSI components and the ways to test the logic circuits.

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.
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.
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. Classify various fabrication technologies and the ways to represent MOS circuits.
2. Design MOS circuits and analyze the factors influencing the operation of CMOS transistor.
3. Analyze the different styles to construct CMOS logic circuits.
4. Analyze CMOS logic to design various digital modules for VLSI system design
5. Analyze the different clocking styles and the methods to test VLSI circuits

Articulation Matrix

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

UNIT I **9 Hours**

FABRICATION OF CMOS IC AND PHYSICAL DESIGN

Silicon Semiconductor technology: Wafer processing, Oxidation, Epitaxy, Diffusion and Silicon gate process - NMOS fabrication - CMOS fabrication: n-well, p-well, Twin tub and SOI Process - Layout design rules - Stick Diagrams - CMOS Logic Gates - Implementation of given logic function using CMOS logic.

UNIT II **9 Hours**

MOS CIRCUIT DESIGN PROCESS

Basic MOS transistors: Symbols, Enhancement mode - Depletion mode transistor operation - Threshold voltage - Body effect - Regions of operation - NMOS inverter- Determination of pull up to pull down ratio - CMOS inverter: DC Characteristics, Switching Characteristics, Power dissipation.

UNIT III **9 Hours**

CMOS LOGIC STYLES

Static CMOS design - Pass Transistor - Transmission Gate - Tri-State Circuits- Pseudo Nmos- Clocked CMOS logic - Dynamic CMOS logic: Domino logic, Charge Keeper Circuits - Dual Rail logic networks: Cascode Voltage Switch Logic.

UNIT IV **9 Hours**

VLSI SYSTEM COMPONENTS

Ripple Carry Adder - Carry Look Ahead Adder - Carry Skip Adder - Carry select Adder - Carry save Adder - Multiplier - Array, Booth, Baugh Wooley

UNIT V **9 Hours**

CLOCKING AND TESTING OF VLSI CIRCUITS

CMOS clocking styles: Clocked logic cascades, Dual non-overlapping clocks, Dynamic logic cascades - CMOS testing: Fault models in CMOS - Test pattern generation methods: Path sensitization, Boolean Difference, Built in self test.

FUTURE READING

CMOS Logic Gates - Equality detector-Pipelining.

Total: 45 Hours

Reference(s)

1. Neil.H.E Weste David Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition, Pearson Addison Wesley, 2015.
2. John P.Uyemura, "Introduction to VLSI circuits and systems", John Wiley, 2016

3. Kamran Eshraghian, Douglas A. Pucknell, Essentials of VLSI Circuits and Systems Prentice Hall of India, 2015
4. Keng,Lable bick,"CMOS Digital Integrated Circuits", Tata McGraw Hill, 2014
5. Rabaey, Chandrakasan and Nikolic, Digital Integrated Circuit: A design Perspective, PHI, Second Edition ,2016

18EC405 ELECTROMAGNETIC FIELDS AND WAVEGUIDES

3 1 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, 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.
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. Apply vector calculus to static electromagnetic fields and analyse the behaviour of static electric field of various geometries and its scalar potential using Coulomb"s Law and Gauss Law.
2. Analyze the behaviour of static magnetic field of various geometries and its vector potential using Biot-Savart Law and Ampere"s Circuital Law.
3. Analyze the boundary conditions of electric and magnetic field and determine the capacitance and inductance of various geometries.
4. Analyze Maxwell"s equation in different forms to determine field waves, potential waves, energy and charge conservation conditions.
5. Analyze the concept of propagating modes, TE and TM decomposition, evanescent modes and cutoff frequency in waveguides.

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 Calculus - Scalar and Vector fields - Coordinate Systems and Transformation, Del -Gradient of a Scalar-Divergence of a Vector and Divergence Theorem-Curl of a Vector and Stokes Theorem, Coulombs Law - Coulombs Law in Vector Form -Electric Field Intensity -Electric Field due to discrete charges - Electric Fields due to Continuous Charge Distributions 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 Potential -Electric Scalar Potential - Relationship between potential and electric field-electric flux density- Gauss Law-Maxwells Equation -Applications of Gauss Law-Point Charge -Infinite Line Charge-Infinite Sheet of Charge -Uniformly Charged Sphere.

UNIT II **9 Hours**

MAGNETOSTATICS FIELDS

Biot- Savart Law and Field Intensity - 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 - Amperes Circuital Law -Applications -infinite line current-infinite sheet of current-infinitely long coaxial transmission line. Magnetic Potential-Magnetic Scalar and Vector Potentials-Magnetic Flux Density - Force due to magnetic field- Lorentz force equation for a moving charge Force on a Current Element-Force between Two Current Elements.

UNIT III **9 Hours**

ELECTROMAGNETIC FIELDS IN MATERIAL SPACE AND BOUNDARY VALUE PROBLEMS

Materials - Properties of materials- convection and conduction current-conductors- polarization in dielectrics- types of dielectrics- continuity equation and relaxation time- Boundary Condition - Boundary conditions for electric fields. Capacitance - Capacitance of various geometries using Laplaces equation-Magnetic materials - classifications - magnetic boundary conditions- Inductors-inductances - magnetic energy stored in inductors.

UNIT IV **9 Hours**

TIME VARYING ELECTROMAGNETIC FIELDS

Maxwells Equations -Faradays Law -Displacement Current -Maxwells Equations in integral form and differential form -Time-Varying Potentials. Wave Propagation-Helmholtz wave Equation-wave motion in free space- perfect dielectric- lossy dielectric and good conductor- skin effect. Poynting vector and power considerations.

UNIT V **9 Hours**

WAVEGUIDES

Plane Waves- 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

Rectangular waveguides-Transverse Magnetic (TM) Modes -Transverse Electric (TE) Modes - characteristic of TE and TM Waves, Impossibility of TEM waves in waveguides, Dominant mode in rectangular wave guide.

Total: 60 Hours

Reference(s)

1. Matthew Sadiku,Elements of Electromagnetics,Oxford University 7/e Press
2. Edward C. Jordon, Keith G. Balmain,Electromagnetic Waves and Radiating Systems,Pearson ,prentice hall.

3. Joseph A.Edminister,Theory and Problems of Electromagnetics-Schaum series-TMH-1993
4. William H Hayt, John A Buck,Engineering Electromagnetics, McGraw-Hill Higher Education, 8th edition, 2011
5. J.D.Kraus and D.A Fleisch,Electromagnetics with applications,5/e-Tata McGraw-Hill- 1999.
6. Bhag Guru and HuseyinHiziroglu,Electromagnetic Field Theory Fundamentals,Cambridge University Press, 2nd edition, 2004

18EC406 MICROPROCESSORS AND MICROCONTROLLERS

3 0 0 3

Course Objectives

- To acquire the basic knowledge of Microprocessor & Microcontroller and applications to understand digital electronic circuits.
- To perform the analysis and design of system design using microprocessor, microcontroller and peripherals.
- To develop the ability to program the processor and controller.

Programme Outcomes (POs)

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

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

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.

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

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

n. 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. Explain the architectural features of 8085 microprocessor
2. Develop an 8085 ALP using appropriate instruction set and addressing modes
3. Describe and Analyze the block diagram and timers of PIC microcontroller.
4. Analyze the ON & OFF-CHIP peripheral interfacing between the peripheral devices and PIC microcontroller.
5. Write an Embedded C program to interface the OFF-chip peripherals with PIC microcontroller

Articulation Matrix

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

UNIT I **9 Hours**

8085 MICROPROCESSOR

8085 Architecture - 8085 Instruction set -8085 Addressing modes - 8085 Timing diagrams

UNIT II **9 Hours**

8085 PROGRAMMING

8085 Assembly language programming - 8085 Interrupts - Memory & I/O device interfacing with 8085 - Serial Communication.

UNIT III **9 Hours**

PIC MICROCONTROLLER

Introduction - PIC 16F family block diagram, Memory organization: Program Memory, Data Memory, I/O Ports, Timer modules: Timer0, Timer 1, Timer 2, Capture/ Compare and PWM module , Counter

UNIT IV **9 Hours**

PIC ON

UART: Registers, modes, ADC: Registers, operation, DAC, EEPROM, I2C, SPI

UNIT V **9 Hours**

OFF-CHIP PERIPHERAL INTERFACING AND PROGRAMMING

RTC Interfacing, SD card interfacing, RFID module interfacing, Microcontroller, and PC communication, Analog Sensor interfacing.

Total: 45 Hours

Reference(s)

1. Ramesh S. Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Fourth edition, Penram International, 2002
2. Muhammed Ali Mazidi, Rolind D Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems", Pearson Edition 2008.
3. Krishna Kant, "Microprocessors and Microcontrollers- Architecture, programming and system design 8085, 8086, 8051,8096", Prentice Hall of India, New Delhi, 2007
4. John B.Peatman, Design with PIC Microcontrollers, Pearson Education Asia, 2002
5. www.microchip.com

18EC407 ANALOG COMMUNICATION LABORATORY

0 0 2 1

Course Objectives

- To provide an introduction on different analog modulation and demodulation systems.
- To learn Pre-emphasis and de-emphasis in FM
- To provide a knowledge on different pulse modulation and demodulation systems.

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.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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. 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	2	3						2				2	
3	2	3	3	2	3				2				2	
4	2	3		2	3				2				2	
5	2	3		2	3				2				2	

1 **4 Hours**

EXPERIMENT 1
Development of Amplitude modulator and demodulator using non linear device.

2 **4 Hours**

EXPERIMENT 2
Development of Frequency modulator and demodulator using IC 8308.

3 **3 Hours**

EXPERIMENT 3
Design Pre-emphasis and de-emphasis in FM.

4 **3 Hours**

EXPERIMENT 4
Design of Mixer circuits.

5 **4 Hours**

EXPERIMENT 5
Analysis of AM and FM signals using Spectrum analyzer.

6 **4 Hours**

EXPERIMENT 6
Development of Pulse Amplitude Modulation using GNU Radio.

7 **4 Hours**

EXPERIMENT 7
Development of FM Modulation using GNU Radio.

8 **4 Hours**

EXPERIMENT 8
Simulation of PAM, PPM and PWM

Total: 30 Hours

Reference(s)

1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition,2016.
2. Communication Systems -B.P. Lathi, BS Publication, 2004.
3. Principles of Communication Systems - H Taub & D. Schilling, Gautam Sahe, TMH, 2007, 3rd Edition.
4. Electronic Communications - Dennis Roddy and John Coolean , 4th Edition , PEA, 2004
5. Communication Systems,Proakis,Communication Systems, 4th Edition, McGraw-Hill Publications.
6. Fundamentals of Communication System,P.Michael Fitz, , Tata McGraw-Hill -2008.

18EC408 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

0 0 2 1

Course Objectives

- To understand and analyze instruction sets of 8085 microprocessor.
- To gain hands-on experience in doing experiments on microprocessors (8085)& PIC microcontroller.
- To interface the microprocessor/microcontroller with various peripherals 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.
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. 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. Perform the basic operations of 8085 microprocessor using Assembly language programming.
2. Perform various operations like sorting,finding the maximum & minimum numbers using 8085 microprocessor
3. Perform basic operations using PIC Microcontroller
4. Perform the basic operations of 8051 microcontroller using Assembly language programming.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Addition and subtraction of two numbers using 8085

2 **2 Hours**

EXPERIMENT 2

Multiplication and division of two numbers using 8085

3 **2 Hours**

EXPERIMENT 3
Sorting of numbers using 8085

4 **3 Hours**

EXPERIMENT 4
Maximum and Minimum numbers using 8085

5 **3 Hours**

EXPERIMENT 5
LED Blinking using PIC

6 **3 Hours**

EXPERIMENT 6
Interfacing switch and LED with PIC

7 **3 Hours**

EXPERIMENT 7
Interrupt programming using PIC

8 **3 Hours**

EXPERIMENT 8
Interfacing LCD with PIC

9 **3 Hours**

EXPERIMENT 9
Interfacing 7 segment with PIC

10 **3 Hours**

EXPERIMENT 10
Interfacing keypad with PIC

11 **3 Hours**

EXPERIMENT 11
USART programming using PIC

Total: 30 Hours

Reference(s)

1. Muhammed Ali Mazidi, Rolind D Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems", Pearson Edition 2008
2. Ramesh S. Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Fourth edition, Penram International, 2002
3. Barry B Brey,"The Intel Microprocessors: Architecture, Programming and Interfacing", Prentice Hall of India, Eighth Edition, 2009.

4. Krishna Kant, " Microprocessors and Microcontrollers- Architecture, programming and system design 8085, 8086, 8051,8096", Prentice Hall of India, New Delhi, 2007

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Explain 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 science
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	1	2												
2	1	1												
3	2	2					1							
4	1													
5	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). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

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

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

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

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

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

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

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

FOR FURTHER READING

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

Total: 30 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. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information

Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

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

Total: 30 Hours

Reference(s)

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

18EC501 DIGITAL COMMUNICATION 3 1 0 4

Course Objectives

- To study the basics of different Digital communication techniques
- To know the basics concept of information theory
- To know the concept and details of error control coding 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.

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

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

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

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

n. 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 of digital data transmission
5. Perform channel coding for error detection/controlling of digital data transmission

Articulation Matrix

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

UNIT I **11 Hours**

PULSE MODULATION

Sources and Signals, Basic Signal Processing Operations in Digital Communication, Channels for Digital Communication.Review of Sampling process (Qualitative): Low pass and Band pass sampling ,Aliasing,Signal Reconstruction Quantization: Uniform & non-uniform quantization, quantization noise, Logarithmic Companding of speech signal Waveform coding: Pulse Code Modulation (PCM) - Differential pulse code modulation - Adaptive differential pulse code modulation - Delta modulation

UNIT II **9 Hours**

BASEBAND TRANSMISSION

Line codes: Need for line shaping of signals, Properties of Line codes, Power Spectral Density of Unipolar / Polar RZ & NRZ, Bipolar NRZ, Manchester Matched Filter, Intersymbol Interference- Nyquist

criterion for distortionless transmission. Pulse shaping and raised cosine filter, Correlative coding, M-ary schemes ,Eye pattern , Equalization

UNIT III **9 Hours**

CARRIER MODULATION

Signal Representation :Orthogonality, Representation of Signals, Generation and detection of Amplitude Shift Keying (ASK) Modulation,Generation and detection of Frequency Shift Keying (FSK)Modulation, Generation and detection of Binary Phase Shift Keying (BPSK) Modulation, Generation and detection of Quaternary Phase Shift Keying QPSK) and QAM Performance of BPSK , QPSK and QAM in AWGN channel structure of Non-coherent Receivers, Principle of DPSK.

UNIT IV **8 Hours**

INTRODUCTION TO INFORMATION THEORY

Measure of information, entropy.Channel capacity and Shannons theorems,source coding techniques: Prefix code ,Huffman Coding,Shannon-Fano-Elias Coding ,Arithmetic Coding, Runlength code. channel capacity, channel coding theorem, Information capacity theorem

UNIT V **8 Hours**

ERROR CONTROL CODING

Channel coding theorem,Linear Block codes,Hamming codes,Cyclic codes,Convolutional codes,Viterbi Decoder, Turbo Codes.

Total: 60 Hours

Reference(s)

1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition,2016.
2. Communication Systems B.P. Lathi, BS Publication, 2004.
3. Analog and Digital Communication - K. Sam Shanmugam, Wiley, 2005.
4. Digital Communications,Proakis, J.G., Salehi, M.,5th Ed., McGraw-Hill International,2008.
5. Digital and Analog Communication Systems,Couch II, L.W., 7th Ed., Pearson,2009.
6. Digital Communications, Sklar, B., 2nd Ed., Pearson, 2001.

18EC502 DIGITAL SIGNAL PROCESSING 3 1 0 4

Course Objectives

- To Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
- To design IIR filters for given specifications by following the suitable design procedures
- To design 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 understand the architectural overview and addressing modes in DSP processors

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.

Course Outcomes (COs)

1. Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
2. Construction of Realization structures and design for IIR filters
3. Construction of Realization structures and design for FIR filters
4. Analyze the effect of finite word length for fixed &floating point number representation.
5. Develop an algorithm using TSM320C6X 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	2	3	2											
2	2	3	2		2									
3	2	3	2		2									
4	2	2	2		2									
5	2	1		3										

UNIT I **9 Hours**

DISCRETE FOURIER TRANSFORM: PROPERTIES, APPLICATIONS AND COMPUTATION

Review on DTFT- Spectrum limitations,The Discrete Fourier Transform- Need for DFT, DFT as a linear transformation. Properties of DFT- Periodicity, Linearity, Symmetry, Multiplication-Circular Convolution, Time Reversal Circular shifts in time and frequency. Linear Filtering based on DFT-Circular Convolution- Overlap add and Overlap save method, Efficient Computation of DFT-FFT algorithm-Implementation of Radix 2 FFT algorithm(DIT and DIF)-Applications of FFT algorithm.

UNIT II **9 Hours**

DESIGN OF IIR FILTERS

LTI systems as frequency selective filters-ideal filter characteristics, LPF, HPF, BPF, notch and Comb filters Invertibility of LTI systems Minimum phase, Maximum phase and mixed phase systems. Introduction to FIR and IIR filters -difference and basic representation-General consideration in the design of digital filters.Design of analogue Butterworth and Chebyshev Filters. Design of IIR digital filters using impulse invariance technique, bilinear transform Realization of IIR filters using direct, cascade and parallel forms.

UNIT III **9 Hours**

DESIGN OF FIR FILTERS

Linear phase FIR filters Design using Frequency sampling techniques using Windows- Hamming, Hanning, Blackman and Kaiser Window. Design of FIR Differentiators Realization of FIR filters-Direct, Linear phase realization structures.

UNIT IV **9 Hours**

FINITE WORD LENGTH EFFECT IN DIGITAL FILTERS

Number representation-Fixed and Floating point Quantization Noise-Finite Word Length Effects in Digital filters- Input Quantization, Product Quantization, Coefficient quantization error, Limit Cycle Oscillations, Overflow and Signal Scaling Introduction to Multirate Signal Processing-Interpolation, Decimation.

UNIT V **9 Hours**

DIGITAL SIGNAL PROCESSORS

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture-Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

Total: 60 Hours

Text Book(s)

1. Digital Signal Processing by John G. Proakis and Dimitris K. Manolakis, 4th edition, Pearson Education India
2. Chassaing,Rulph,DSP applications using C and the TMS320C6x DSK. Vol 13. John Wiley and Sons,2003
3. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall
4. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY.
5. Understanding Digital Signal Processing,Lyons,Richard G., 3/e, Pearson Education India,2004
6. Digital Signal Processing: A Practical Approach,Barrie W. Jervis and Emmanuel C. Ifeachor2/e, Pearson Education India,2009

18EC503 TRANSMISSION LINES AND ANTENNAS 3 1 0 4

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, 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.
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. 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 Huygens 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 **10 Hours**

TRANSMISSION LINE THEORY

Different types of transmission lines-open wire line, cables, co-axial line, waveguides. Properties of symmetrical network- characteristic impedance and Propagation Constant - Infinite line and short line, the transmission line as a cascade of T Sections. General Solution of the transmission line- physical significance of the equation, wavelength and velocity of propagation, reflection on a line not terminated by Zo. Distortion -Waveform Distortion-Distortion due to Z0 varying with frequency, Frequency Distortion, Phase Distortion, Distortion less transmission line. The telephone cable- Inductance loading of telephone cables.

UNIT II **8 Hours**

THE LINE AT RADIO FREQUENCIES

Input impedance of lossless lines. Standing waves and standing wave ratio on a line-Relation between SWR and magnitude of reflection coefficient. Input impedance of a lossless line terminated by impedance. One

eighth wave line, The Quarter waveline,The Half wave line. The Smith chart- Application of the Smith Chart, single stub matching, Double stub matching.

UNIT III **9 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- Half-wave dipole, quarter-wave monopole and folded dipole. Antenna Parameters- Radiated Power Density,Radiation Intensity, Power radiated, Gain, Directivity, efficiency, bandwidth, polarization, 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.

UNIT IV **9 Hours**

TRAVELING WAVE ANTENNAS

Radiation from a travelling wave on a wire.-Analysis of V antenna. Analysis and Design of Rhombic antenna- Broadband antennas.Aperture concept- Effective aperture, Huygens principle, Uniqueness theorem, Field Equivalence principle and Duality theorem, Radiation from an elemental area of a plane wave (Huygens Source). Radiation from a rectangular aperture treated as an array of Huygens sources. Babinets 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 earths 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.

Total: 60 Hours

Text Book(s)

1. Antenna Theory Analysis and Design, Constantine A.Balanis , Antenna Theory , John Wiley, 3rd Edition, 2005
2. Antenna and Wave Propagation K.D.Prasad., Antennas and wave propagation, Sathya Praksham, 2001

Reference(s)

1. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems" Prentice Hall of India 2nd edition 2003.
2. J.D.Ryder, "Networks, Lines and Fields", PHI, 2nd Edition, 2010.

18EC504 CONTROL SYSTEMS 3 1 0 4

Course Objectives

- To understand the control system representation
- To analyse the control system in terms of time domain specifications
- To determine the stability of a control system from its transfer function
- To analyse the control system in terms of frequency domain specifications
- To understand the state space analysis of control systems

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.

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

Course Outcomes (COs)

1. Represent a control system using block diagram and signal flow graph.
2. Analyse the time response of a control system using time domain specifications.
3. Analyse the stability of a control system.
4. Analyse the frequency response of a control system using frequency domain specifications.
5. Analyse a control system using state space analysis method.

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 **10 Hours**

CONTROL SYSTEMS REPRESENTATION

Introduction to Control systems-Classification of Control Systems - Open loop and Closed loop control systems-Effects of Feedback-Transfer function-Modelling of Physical systems - Electrical systems-System representation using Block diagram and Signal flow graph-Block diagram reduction techniques-Signal flow graph reduction using Masons gain formula.

UNIT II **9 Hours**

TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS

Standard test signals-Time response of First order control systems for step input-Time response of Second order control systems for step input-Time domain specifications-Effects of poles and zeros-Steady state error-Controllers- PI, PD, PID controllers.

UNIT III **8 Hours**

STABILITY ANALYSIS OF CONTROL SYSTEMS

Introduction to stability-Stability and the roots of characteristic equation-Routh Hurwitz stability criterion-Range for parameters -conditionally stable systems-Root locus plot-Control system design using root locus plot.

UNIT IV **9 Hours**

FREQUENCY RESPONSE ANALYSIS OF CONTROL SYSTEMS

Closed loop frequency response-Frequency domain specifications-Polar plot-Bode Plot-Nyquist Stability Criterion- Nyquist Plot-Gain and Phase Margins.

UNIT V **9 Hours**

COMPENSATORS AND STATE SPACE ANALYSIS

Compensators-Lead, Lag and Lag-Lead Compensation-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.

Total: 60 Hours

Reference(s)

1. Ogata K,Modern Control Engineering, 5th edition, PHI, 2010.
2. D.RoyChoudhury, Modern Control Engineering, 2nd edition, PHI, 2006.
3. I.J.Nagrath, and M.Gopal, Control Systems Engineering, 6th edition, New Age International, 2016.

18EC507 DIGITAL SIGNAL PROCESSING LABORATORY

0 0 2 1

Course Objectives

- To get an understanding for Matlab in various signal processing applications
- To Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
- To design IIR and FIR filters for given specifications by following the suitable design procedures
- To understand the architectural overview and addressing modes in DSP processors
- To understand the architectural overview and addressing modes in DSP processors

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.
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.

n. 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 frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
2. Construction of Realization structures for FIR and IIR filters
3. Design FIR filter and IIR filters and analyse its response
4. Develop an algorithm using TSM320C6X 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	3	3	1		2									1
2	2	3	2		2									1
3	1	2	3		2									2
4		2	3		2									2

1 **2 Hours**

EXPERIMENT 1

Introduction to Matlab for Signal Processing

2 **3 Hours**

EXPERIMENT 2

Sampling of Continuous time Signals

3 **3 Hours**

EXPERIMENT 3

Linear and Circular Convolution (with and without functions)

4 **4 Hours**

EXPERIMENT 4

Computation of DFT of a signal using basic equation,FFT algorithms

5 **4 Hours**

EXPERIMENT 5

Design and Simulation of IIR and FIR filters

6 **4 Hours**

EXPERIMENT 6

Design and Simulation of IIR and FIR filters using Filter design ToolBox

7 **2 Hours**

EXPERIMENT 7

Linear Convolution using Simulink

8 **2 Hours**

EXPERIMENT 8

Generation of Signals using DSP Kit

9 **3 Hours**

EXPERIMENT 9

Convolution Operation using DSP Kit

10 **3 Hours**

EXPERIMENT 10

Implementation of FFT algorithms using DSP Kit

Total: 30 Hours

Text Book(s)

1. Digital Signal Processing by John G. Proakis and Dimitris K. Manolakis, 4th edition, 2007, Prentice Hall, Upper Saddle River, NJ
2. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall, Upper Saddle River, NJ
3. Digital Signal Processing: A Practical Approach,Barrie W. Jervis and Emmanuel C. Ifeachor2/e, Pearson Education India,2009

18EC508 DIGITAL COMMUNICATION AND ANTENNAS LABORATORY

0 0 2 1

Course Objectives

- To learn the different digital modulation techniques and their detection
- To provide knowledge on Software defined radio and GNU Radio software.
- To study various antennas, arrays and radiation patterns of antennas.
- To understand various techniques involved in various antenna parameter measurements and the propagation of radio waves.

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.
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. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 characteristics of Pulse Code Modulation and Delta Modulation schemes in digital communication
2. Design and analyze the performance of digital modulation and demodulation schemes using GNU Radio.
3. Analyze the characteristics of AWGN and Rayleigh fading channel in Digital communication system.
4. Measure the Radiation pattern of Horn Antenna and Parabolic Antenna and Analyze the impedance matching networks and transmission lines.
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	2	3											2	
2	1	3				2							2	
3	2	1									2			1
4	1	2	1	2	2								2	
5	2	2	1	2			2						2	

1 **2 Hours**

EXPERIMENT 1

Design and development of PCM modulator and demodulator.

2 **2 Hours**

EXPERIMENT 2

Design and development of Delta modulator.

3 **3 Hours**

EXPERIMENT 3

Design and development of Amplitude Shift keying and Phase Shift keying Modulator.

4 **2 Hours**

EXPERIMENT 4

Development of Quadrature Phase Shift keying signal Modulator and demodulator using GNU Radio.

5 **2 Hours**

EXPERIMENT 5

Development of Binary Phase Shift keying signal Modulator and demodulator using GNU Radio.

6 **2 Hours**

EXPERIMENT 6

Simulation of BPSK and QPSK modulation and demodulation using MATLAB.

7 **2 Hours**

EXPERIMENT 7

Design and analysis BER performance of BPSK/QPSK in AWGN and Rayleigh fading channel.

8 **3 Hours**

EXPERIMENT 8

Simulation of Impedance Matching Networks.

9 **3 Hours**

EXPERIMENT 9

Simulation of transmission lines.

10 **3 Hours**

EXPERIMENT 10

Simulation of array factor of linear array - Broadside, End-fire array and Binomial Array.

11 **3 Hours**

EXPERIMENT 11

Measurement of Radiation pattern of Horn antenna and Parabolic Antenna.

12 **3 Hours**

EXPERIMENT 12

Design and simulation of Microstrip Patch Antenna.

Total: 30 Hours

Reference(s)

1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition,2016.
2. Communication Systems - B.P. Lathi, BS Publication, 2004.
3. Analog and Digital Communication - K. Sam Shanmugam, Wiley, 2005.
4. Digital Communications,Proakis, J.G., Salehi, M.,5th Ed., McGraw-Hill International,2008.
5. C A Balanis, Antenna Theory Analysis and Design, 3rd Edition, John Wiley Publishers, 2005
6. K.D.Prasad, Antennas and Wave Propogation, Sathya Prakasan, 3rd Edition, New Delhi, 2001.

18GE501 SOFT SKILLS - APTITUDE I **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

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

1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **3 Hours**

AVERAGES AND AGES

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

4 **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 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **2 Hours**

TIME AND WORK

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

7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

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

9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10 **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.

11 **3 Hours**

DIRECTION

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

12 **3 Hours**

CRITICAL REASONING

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

Total: 30 Hours

Reference(s)

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

18HS003 PRINCIPLES OF MANAGEMENT 2 0 0 2

Course Objectives

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

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

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								2			2			
4								2			2			
5								2			2			

UNIT I **6 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

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

UNIT II **6 Hours**

PLANNING

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

UNIT III **6 Hours**

ORGANISING

Nature and purpose - Formal and informal organization - Organization chart - Organization Structure and Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design-Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **6 Hours**

DIRECTING

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

UNIT V **6 Hours**

CONTROLLING

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

Total: 30 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.

3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007..
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008

18EC602 COMPUTER NETWORKS AND PROTOCOLS 3 0 0 3

Course Objectives

- To understand the fundamental concept of networks and issues involved in it.
- To acquire an insight view and knowledge to design various layer protocols on the set of rules and procedures that mediates the exchange of information between communicating devices.
- To understand the basic concepts of application layer protocol design including client/server models.

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.
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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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. Interpret OSI and TCP/IP models, Layers, transmission media and basic topologies with existing and emerging computer networks.
2. Apply the appropriate random access protocols, flow and error control schemes to solve the data link layer issues.
3. Analyze the network layer impairments by giving solutions, with an understanding of the underlying switching techniques, router architectures, algorithms and protocols.
4. Analyze the performance of transport layer protocols and the beneficial effects of adopting suitable congestion control schemes.
5. Apply the existing network technologies to enable the design and development energy efficient network technologies in near future.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO NETWORKS

Network architecture - Topology - Types (LAN, MAN, WAN & PAN) - Network Switching Types: Circuit and packet switching - OSI Reference Model - TCP/IP model - Comparison. Different types of transmission media - Errors in transmission: attenuation, noise - Repeaters - Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.).

UNIT II **9 Hours**

MAC AND DATA LINK LAYER

MAC Layer: Aloha - CSMA - CSMA/CD - CSMA/CA protocols -Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth, VLAN and WiMax - Bridges and its types. Data Link Layer: Error detection (Parity, CRC, Checksum) - Sliding Window - Stop and Wait protocols.

UNIT III **9 Hours**

NETWORK LAYER

Internet Protocol - IPv6 - ARP - DHCP - ICMP - Routing algorithms: Distance vector, Link state, Metrics, Inter domain routing - Subnetting - Classless addressing - Network Address Translation.

UNIT IV **9 Hours**

TRANSPORT LAYER

Connectionless: UDP - Stop and Wait - Pipelined - Go back N - Selective repeat. Connection Oriented: TCP Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions.

UNIT V **9 Hours**

APPLICATION LAYER

Architecture: Client server & P2P - Protocols: HTTP, SMTP, DNS - Video streaming and Content Distribution Networks:Types, Case study - Socket Programming.

Total: 45 Hours

Reference(s)

1. Kurose and Ross, "Computer Networking - A top-down approach", Seventh Edition, Pearson, 2017.
2. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education India, 2013.
3. Srinivasan Keshav, "Mathematical Foundations of Computer Networking ", Addison-Wesley Professional, 2012.
4. Peterson and Davie, "Computer Networks, A Systems Approach", 5th ed., Elsevier, 2011.
5. Fred Halsall, "Computer Networking and the Internet ", (5th Edition), Addison Wesley, 2005.

18EC603 DIGITAL VLSI SYSTEM DESIGN 3 0 0 3

Course Objectives

- To model the digital logics using Verilog HDL.
- To understand the FPGA fundamentals, design and implementation of circuits
- To understand the concepts of ASIC Front and Backend Design.

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.
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. Design a digital logics using Verilog HDL
2. Design a digital logics using advanced Verilog HDL and verify using test bench
3. Design a digital systems using Verilog HDL
4. Analyze the programmable IC technologies
5. Analyze the ASIC implementation process

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

UNIT I **9 Hours**

BASICS OF VERILOG HDL

Importance of HDL - Design Methodologies - Basic Concepts - Data Types - Dataflow Modeling - Verilog Operators - Gate Level Modeling - Behavioural Modeling: if, else, case statement

UNIT II **8 Hours**

ADVANCED VERILOG HDL AND TEST BENCHES

Switch Level Modeling - Tasks - Functions - User Defined Primitives (UDP) - Timing and Delays - Verilog Test Benches for Combinational Logic Modules and Sequential Digital Circuits

UNIT III **10 Hours**

SYSTEM DESIGN USING VERILOG HDL

ALU - Magnitude Comparator - Multiplication Unit - Adder/Subtractor - MAC Unit - FIR Filter - Barrel Shifter - Random Number Generator - Traffic Light Controller - Vending Machine Controller- Single Port RAM

UNIT IV **9 Hours**

PROGRAMMABLE IC TECHNOLOGIES

PROM, PLA, PAL ,CPLD Programmable IC Technologies - Introduction to FPGA - FPGA Implementation Process - FPGA EDA Tools - FPGA Internal Architectures - Logic Implementation using LUTs - Programmable Interconnections

UNIT V **9 Hours**

ASIC TECHNOLOGIES

ASIC Design Flow - Types of ASICs - VLSI Design Automation tools - Design Synthesis- Constructive & Iterative Partition and Placement Algorithm - Clock Tree Synthesis - Lee Maze Routing Algorithm - Static Timing Analysis - Physical Verification - File Formats

FURTHER READING

FIFO - Actel ACT - Floor Plan - Power Planning

Total: 45 Hours

Reference(s)

1. Stephen Brown and Zvonko Vranesic,Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Tata McGraw Hill, 2014.
2. Samir Palnitkar,Verilog HDL, Pearson Education, 2nd Edition, 2004.
3. Ion Grout, Digital Systems Design with FPGAs and CPLDs, Elsevier, 2008.
4. M.J.S.Smith, Application Specific Integrated Circuits, Pearson Education, 2008.
5. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002.
6. Ming-Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, 2012.

18EC604 EMBEDDED SYSTEMS 3 0 2 4

Course Objectives

- To study the Architecture used in ARM Architecture Design
- To learn the programming concepts using ARM and PIC
- To analyze various embedded communication protocols
- To learn RTOS concepts and its 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.
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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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. Describe about hardware and software architectures of Embedded Systems
2. Explain the operational features, addressing modes and instruction set of PIC microcontroller and analyze the concept of pipelining.
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	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**

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 **9 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 III **9 Hours**

LPC 2378 MICROCONTROLLER

Introduction, Features, Architectural overview, ARM7TDMI-S processor, Block diagram, Memory map and peripheral addressing, System control block functions, Interrupt controller, Interrupt sources

UNIT IV **9 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 **9 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- Semaphore- Message Mailboxes- Message Queues, Interrupts- Interrupt Latency-Interrupt Response- Interrupt Recovery- RTOS: RT Linux - VX Works - UCOS.

1 **4 Hours**

EXPERIMENT 1

Interface Switches and LEDs using LPC 2378

2 **4 Hours**

EXPERIMENT 2

Interface LCD and Display "Hello World" using LPC 2378

3 **5 Hours**

EXPERIMENT 3

Interface 4*4 Matrix Keyboard using LPC 237

4 **5 Hours**

EXPERIMENT 4

Interface I2C enabled 7 Segment Display using LPC 2378

5 **6 Hours**

EXPERIMENT 5

Interfacing Analog to Digital Converter using LPC 2378

6 **6 Hours**

EXPERIMENT 6

Implementing Relay Control using LPC 2378

Total: 75 Hours

Text Book(s)

1. Steve Furber, "ARM System on Chip Architecture" Addison- Wesley Professional Second Edition, Aug 2000

Reference(s)

1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design",Morgan Kaufman Publishers, First Indian Reprint, 2001

2. LPC2364/66/68/78 User manual
3. Raj Kamal, "Embedded Systems Architecture Programming and Design", Second Edition,TMH, 2010.
4. MicroC/OS-II: The Real-Time Kernel by Jean J. Labrosse

18EC607 COMPUTER NETWORKS LABORATORY 0 0 2 1

Course Objectives

- To understand the fundamental concept of networks and issues involved in it.
- To provide an insight view and knowledge to design various layer protocols on the set of rules and procedures that mediates the exchange of information between communicating devices.
- To understand the fundamental concepts of application layer protocol design including client/server models.

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.
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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 the point to point network using connection oriented and connection less links.
2. Analyse the performance metrics for different network topology in computer networks.
3. Analyse the performance metrics evaluation for Ethernet LAN at sparse and dense network conditions with congestion.
4. Design the simple ESS and Wireless LAN using Leaky bucket algorithms.
5. Assess the suitable path for effective transmission from various routing protocol algorithm by analyzing its performance metrics.

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

Simulate a three nodes point-to-point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packers dropped.

2 **3 Hours**

EXPERIMENT 2

Simulate a four node point-to-point network and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP / UDP.

3 **3 Hours**

EXPERIMENT 3

Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packers dropped due to congestion.

4 **3 Hours**

EXPERIMENT 4

Write a program for error detecting code using CRC-CCITT (16-bits).

5 **3 Hours**

EXPERIMENT 5

Simulate an Ethernet LAN using N nodes (6-10). Change error rate and data rate and compare throughput.

6 **3 Hours**

EXPERIMENT 6

Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source / destination.

7 **3 Hours**

EXPERIMENT 7

Simulate simple ESS and with transmitting nodes in wireless LAN by simulation and determine the performance with respect to transmission of packets.

8 **3 Hours**

EXPERIMENT 8

Write a program for congestion control policies/algorithms

9 **3 Hours**

EXPERIMENT 9

Using TCP/IP sockets, write a client server program to make client sending the file name and the server to send back the contents of the requested file if present.

10 **3 Hours**

EXPERIMENT 10

Write a program for distance vector algorithm to find suitable path for transmission.

Total: 30 Hours

Reference(s)

1. Ying-Dar Liu, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill, 2011.
2. W Stallings, Cryptography and Network Security, Principles and Practice, 5th Ed., Prentice-Hall, 2010
3. Srinivasan Keshav - Mathematical Foundations of Computer Networking-Addison-Wesley Professional (2012)
4. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education India, 2013.
5. Michael Donahoo, Ken Calvert, Pocket Guide to TCP/IP Socket Programming in C, Morgan Kaufmann Series in Networking, 2000.
6. W. Richard Stevens, Bill Fenner and Andrew Rudoff, "Unix Network Programming", Volumes 1 and 2, Third Edition, Addison-Wesley Professional, 2003.

18EC608 VLSI DESIGN LABORATORY 0 0 2 1

Course Objectives

- To apply HDL programming for implementation of digital circuits in FPGA and ASIC Technologies
- To design a digital system using System generator and IP core generator
- To draw the VLSI layout using ASIC EDA tools

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 module using IP Core and system generator.
2. Design and simulate digital logics using Verilog HDL
3. Import the logic modules into FPGA Boards

4. Synthesize the Digital Logic using ASIC EDA tools
5. Draw the Layout using ASIC EDA Tool

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Model a Random Access Memory (RAM) using IP Core Generator

2 **4 Hours**

EXPERIMENT 2

Simulate the following Digital Circuits using HDL
a. Ripple Carry Adder
b. Flip Flops

3 **6 Hours**

EXPERIMENT 3

Simulate the following Digital Systems using HDL
a. Real Time Clock
b. Traffic Light Controller using FSM

4 **4 Hours**

EXPERIMENT 4

Implement the following Digital Circuits on FPGA
a. Magnitude Comparator
b. ALU

5 **2 Hours**

EXPERIMENT 5

Implement a MAC Unit using System Generator

6 **6 Hours**

EXPERIMENT 6

Synthesize 4 bit parallel multiplier using 90nm technology file. Evaluate area, power and delay performance using ASIC EDA tool.

7 **6 Hours**

EXPERIMENT 7

Design, Simulate and Generate the GDSII/CIF File for the following using ASIC EDA Tool also report the performance parameters.

a.CMOS Inverter
b.CMOS NAND
c.CMOS NOR

Total: 30 Hours

Reference(s)

1. Stephen Brown and Zvonko Vranesic,Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Tata McGraw Hill, 2014.
2. Samir Palnitkar,Verilog HDL, Pearson Education, 2nd Edition, 2004.
3. Ion Grout, Digital Systems Design with FPGAs and CPLDs, Elsevier, 2008.
4. M.J.S.Smith, Application Specific Integrated Circuits, Pearson Education, 2008.
5. Ming-Bo Lin,Digital System Designs and Practices using Verilog HDL and FPGAs,Wiley, 2012.
6. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002.

18GE601 SOFT SKILLS-APTITUDE II 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

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

Articulation Matrix

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

1 2 **Hours**

PERMUTATION AND COMBINATION

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

2 2 **Hours**

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 2 **Hours**

SYLLOGISM AND VENN DIAGRAM

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

4 2 **Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

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

5 2 **Hours**

MIXTURES AND ALLIGATION

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

6 2 **Hours**

CUBE AND LOGARITHM

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

7 2 **Hours**

DATA INTERPRETATION

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

8 2 **Hours**

PROGRESSION AND LOGICAL REASONING

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

9 2 **Hours**

PROBLEM ON AGES

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

10 2 **Hours**

ANALYTICAL REASONING

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

11 2 **Hours**

BLOOD RELATION

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

12 4 **Hours**

VISUAL REASONING

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

13 4 **Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles. **Total:30Hours**

Reference(s)

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

18HS002 PROFESSIONAL ETHICS IN ENGINEERING 2 0 0 2

Course Objectives

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

Programme Outcomes (POs)

h. 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. Articulate engineering ethics theory with sustained lifelong learning.
2. Adopt a good character and follow high professional ethical life.
3. Contribute to shape a better character by following ethical actions.
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment by established experiments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2			2			
2								2			2			
3								2			2			
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 - Kohlbergs and Gilligans theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse.

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

Sample code of ethics like IETE,ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P)limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

18EC702 WIRELESS COMMUNICATION 3 0 2 4

Course Objectives

- To impart the fundamentals concepts of wireless communication systems.
- To introduce various technologies and protocols involved in wireless cellular communication.
- To understand the concepts of signalling schemes for fading channels and analyze its channel capacity.

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.
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. 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. Assess and select the appropriate multiple accessing methods and propagation path loss model depending on channel model.
2. Apply the innovative ideas in the field of wireless communication, in particular how to communicate effectively and efficiently in wireless cellular communication.
3. Illustrating the concepts using examples from several modern wireless systems as well as new research developments.
4. Analyze the mathematical framework for design of wireless systems developed based on suitable equalization and diversity techniques.
5. Apply the innovative ideas to improve the existing technology in the field of digital communication through fading multipath channels and improving capacity in Wireless systems

Articulation Matrix

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

UNIT I **9 Hours**

PROPAGATION AND MULTIPLE ACCESS TECHNIQUES

Fading - Multipath propagation mechanisms - Propagation Models: Free space model, Two ray ground reflection model, Macro cell and Micro cell propagation models. Multiple Access Techniques: FDMA, CDMA, TDMA, SDMA.

UNIT II **9 Hours**

CELLULAR MOBILE WIRELESS SYSTEMS

Cellular Systems: Structure - Cell Cluster - Frequency reuse - Channel Interference - Cell splitting and sectoring - Channel Assignment schemes: Fixed, Dynamic and Hybrid - Network Architecture - Mobility Management - Location Management - Resource Management: Microcell Concept.

UNIT III **9 Hours**

WIDEBAND SYSTEMS

GSM Network Architecture - GPRS: Network Architecture, Signaling, Mobility management, Location Management, Roaming. CDMA: IS95 systems, Forward link, Reverse Link, PN sequence related to CDMA - UMTS: Network Architecture and Interface.

UNIT IV **9 Hours**

EQUALIZATION AND DIVERSITY TECHNIQUES

Fundamentals of equalization - Equalizers in communication receivers: Linear equalization, Non-linear equalization: DFE, MLSE Equalizer, Adaptive Equalizer. Diversity Techniques: Time diversity, Antenna diversity, Frequency diversity: Single carrier with ISI, DSSS, OFDM.

UNIT V **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.

1 **3 Hours**

EXPERIMENT 1

Simulation of Channel model for Free space propagation loss and log normal shadowing models

2 **3 Hours**

EXPERIMENT 2

Simulation of Frequency Division Multiple access transmitter and receiver systems using MATLAB

3 **3 Hours**

EXPERIMENT 3

BER simulation of OFDM system over multipath fading channel.

4 **3 Hours**

EXPERIMENT 4

BER simulation of OFDM system over multipath fading channel.

5 **3 Hours**

EXPERIMENT 5

Simulation of Frequency Division Multiple access techniques for communication systems

6 **3 Hours**

EXPERIMENT 6

Simulation of CDMA transmitter and receiver using MATLAB

7 **3 Hours**

EXPERIMENT 7

Simulation of Direct sequence spread spectrum modulation and demodulation using MATLAB

8 **3 Hours**

EXPERIMENT 8

Analysis and comparison of BPSK/QPSK BER performance in Rayleigh and Racian fading channel

9 **3 Hours**

EXPERIMENT 9

Generation of OFDM Transmitter and receiver systems using SDR kit

10 **3 Hours**

EXPERIMENT 10

Generation of OFDM Transmitter and receiver systems using SDR kit

Total: 75 Hours

Reference(s)

1. Cory Beard and William Stallings, "Wireless Communication Networks and Systems" Pearson, 2015.
2. ITI Saha Misra, "Wireless Communication and Networks : 3G and beyond", McGraw Hil Education Pvt Ltd., Second edition, 2013.
3. K. Daniel Wong, "Fundamentals of Wireless Communication Engineering Technologies" Wiley, 2012.
4. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005
5. T.S.Rappaport, Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.
6. Mischa Schwartz, "Mobile Wireless Communications",Cambridge University Press, 2005.

18EC703 RF AND MICROWAVE ENGINEERING 3 1 0 4

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, 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.
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. Analyze the working and performance of RF and Microwave Passive Devices.
2. Design and analyze different filter techniques and its characteristics
3. Analyze the working and performance of Microwave signal generators.
4. Analyze the working of high frequency 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		1										2	
4	1	2	3										2	
5	1	2	3										2	

UNIT I **10 Hours**

HIGH FREQUENCY NETWORK CHARACTERIZATION AND PASSIVE DEVICES

Basic Definitions of Networks; Interconnecting Networks; Scattering Parameters: Definition, Chain Scattering Matrix, Conversion of S-parameters, Generalized S-parameters and Practical Measurements; S parameter representation of N port networks, properties -S Matrix of a Directional Coupler- waveguide tees and rat race coupler-Qualitative discussion on: Waveguide Corners- Bends- Twists- Matched loads and movable shorts.RF Passive Components: Resistor, Inductor and Capacitor at High Frequency; Chip Resistor, Chip Capacitor and Surface Mounted Inductors, Microstrip lines.

UNIT II **9 Hours**

HIGH FREQUENCY CIRCUITS

Filter Design: Basic Resonator and Filter Configuration: Filter Types and Parameters; LPF, HPF, BPF, BSF, Insertion Loss; Filter Realization: Butterworth, Chebyshev type Filters, Denormalization of standard LPF; Filter Implementation: Unit Elements, Kurodas Identities, Microstrip Filter Design; Amplifier Design: Characteristics, Power Relations, Stability considerations, Constant Gain, Noise Figure and Constant VSWR circles.

UNIT III **9 Hours**

MICROWAVE SIGNAL GENERATOR

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 IV **9 Hours**

HIGH FREQUENCY 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; RF Bipolar Junction Transistor, RF Field Effect Transistor: Construction, High Electron Mobility Transistor: Functionality, Frequency Response, Temperature Behaviour and Noise Performance.

UNIT V **8 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.

Total: 60 Hours

Reference(s)

1. David.M.Pozar, Microwave Engineering, John Wiley, 2003
2. Samuel.Y.Liao, MicrowaveDevices and Circuits, PHI, 2000.
3. Reinhold Ludwig, Gene Bogdanow, RF Circuit Design-Therory and Applications, Pearson, 2011
4. Annapurna Das and SisirK.Das,Microwave Engineering, Tata Mc Graw-Hill,2000.
5. R.E.Collin, Foundations for Microwave Engineering - IEEE Press 2002.International, 1999.
6. Sushrut Das,Microwave Engineering, Oxford university Press, 2014

18EC704 OPTICAL COMMUNICATION 3 0 0 3

Course Objectives

- Awareness on different components of a optical link and phenomena involved light propagation through various fibre configurations
- Understanding of the issues in propagation of light through medium and the consequences like attenuation mechanisms (losses) and signal degradation (dispersion effects)
- Characteristics of transmitters and their suitability to different types optical communication links.
- Receiver characteristics and their optimization to achieve low BER.
- Determination of choice of components for deployment of a given optical link based on link power (losses) and rise time (dispersive) budget.

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 behaviour of different optical medium (fibers) and performance of signal Propagation.
2. Analyze the issues in propagation of optical signals resulting from signal degradation mechanism of optical fiber media.
3. Analyze the performance of light sources and apply the concept for choice of light sources for a given optical link.
4. Apply the concept of working of optical receivers and identify the type of receiver for different optical links.
5. Assess the power loss and signal dispersive nature of optical media and apply the result to identify appropriate transmitter, receiver, on line.

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 Waveguides- 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 Waveguides-Information Capacity determination. Group Delay-Material Dispersion, Waveguide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling, Design Optimization of SM fibers. RI profile and cut-off wavelength.

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

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, Probability of Error. Quantum Limit.

UNIT V **9 Hours**

DIGITAL TRANSMISSION SYSTEM AND MEASUREMENTS.

Point to Point links System considerations, Power budget, 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, Field Measurements.

Total: 45 Hours

Reference(s)

1. Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 5th edition. 2013.
2. J.Gower, Optical Communication System, Prentice Hall of India, 2001. Copy right 2002
3. J.H. Franz, V.K. Jain, Optical Communication-Components and Systems, Narosa Publishing House, 2000.
4. J.Senior, Optical Communication, Principles and Practice, Prentice Hall of India, Third edition published 2009.

18EC707 HIGH FREQUENCY COMMUNICATION 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
- Th study the characteristics like attenuation and bandwidth of a given optical fiber cable.
- To analyze the characteristics of optical sources.

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.
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. Analyze the mode characteristics of Reflex Klystron and Gunn Diode.
2. Calculate the power distribution in microwave components and the scattering parameters of various Tees.
3. Compute the frequency and wavelength of rectangular and circular waveguides
4. Analyze the issues in the propagation of optical signals through optical fibers
5. Apply the concept of WDM using single mode optical fiber cable.

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	1	2											2	
5	1	2	3										2	

1 **4 Hours**

EXPERIMENT 1
Characteristics of reflex klystron

2 **2 Hours**

EXPERIMENT 2
Characteristics of Gunn diode

3 **4 Hours**

EXPERIMENT 3
Scattering parameters of Microwave Tee junctions

4 **3 Hours**

EXPERIMENT 4
Characteristics of Directional coupler

5 **4 Hours**

EXPERIMENT 5
Analysis of microwave network parameters(Attenuation, Impedance,frequency and VSWR measurement).

6 **2 Hours**

EXPERIMENT 6
D.C. Characteristics of LED and PIN Photo Diode

7 **2 Hours**

EXPERIMENT 7
WDM using Fiber Optic Passive Component Module and Dual Source Kit

8 **2 Hours**

EXPERIMENT 8
BER measurement Advanced Fiber optic communication Trainer kit. (Link A and B.).

9 **2 Hours**

EXPERIMENT 9
Measurement of losses in optical fiber cable.

10 **3 Hours**

EXPERIMENT 10
Design and Simulation of RF filter.

11 **2 Hours**

EXPERIMENT 11
Design and Simulation of microwave couplers.

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

18EC708 PROJECT WORK I **0 0 6 3**

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, 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.

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			

18EC804 PROJECT WORK II **0 0 18 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, 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 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 broadest 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			

18HS201 COMMUNICATIVE ENGLISH II **1 0 2 2**

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

GRAMMAR3

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

UNIT II **9 Hours**

READING

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

UNIT III **9 Hours**

WRITING

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

UNIT IV **9 Hours**

LISTENING

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

UNIT V **9 Hours**

SPEAKING

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

Total: 45 Hours

Reference(s)

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

18HSH01 HINDI 1 0 2 2

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

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

UNIT I **9 Hours**

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 long vowels and short vowels - -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

Reference(s)

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

18HSG01 GERMAN **1 0 2 2**

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. listen and identify individual sounds of German
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

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

UNIT I **9 Hours**

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

UNIT II **9 Hours**

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

UNIT III **9 Hours**

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

UNIT IV **9 Hours**

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

UNIT V **9 Hours**

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

Total: 45 Hours

Reference(s)

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

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

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

UNIT I **9 Hours**

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

UNIT II **9 Hours**

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

UNIT III **9 Hours**

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

UNIT IV **9 Hours**

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

UNIT V **9 Hours**

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

Total: 45 Hours

Reference(s)

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

18HSC01 CHINESE 1 0 2 2

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

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

UNIT I **9 Hours**

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

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

UNIT IV **9 Hours**

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

UNIT V **9 Hours**

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

Total: 45 Hours

18HSF01 FRENCH **1 0 2 2**

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

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

UNIT I **9 Hours**

ENTRER EN CONTACT

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

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

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

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

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

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT - OUVRIR -Ãƒ?Ã‚Â LA CULTURE

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

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

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

Total: 45 Hours

Reference(s)

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

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

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

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

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

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

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

UNIT II **9 Hours**

P-N JUNCTION

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

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

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

UNIT IV **9 Hours**

MOSFET

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

UNIT V **9 Hours**

PHOTONIC DEVICES

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

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

18GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

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

UNIT I **9 Hours**

LASER FUNDAMENTALS

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

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

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

UNIT III **9 Hours**

LASERS IN SCIENCE

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

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

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

UNIT V **9 Hours**

LASERS IN INDUSTRY

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

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009

5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

18GE0C1 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

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

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio

and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

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

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

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

UNIT V **10 Hours**

CORROSION CONTROL METHODS

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

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

18GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, 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. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Compare different methods of storing hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-

cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

18GE0C3 POLYMER SCIENCE 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - 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: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

18GE0M1 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

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

UNIT II **9 Hours**

TREES, CONNECTIVITY

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

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

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

UNIT IV **9 Hours**

PERMUTATIONS

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

UNIT V **9 Hours**

GENERATING FUNCTIONS

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

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007

4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

18GE0M2 ALGEBRA AND NUMBER THEORY 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

Articulation Matrix

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

UNIT I **9 Hours**

FIELDS

Group Theory - Rings and Polynomials - Fields.

UNIT II **9 Hours**

FINITE FIELDS AND POLYNOMIALS

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

UNIT III **9 Hours**

DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS

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

UNIT IV **8 Hours**

DIOPHANTINE EQUATIONS AND CONGRUENCES

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

UNIT V **10 Hours**

CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS

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

Total: 45 Hours

Reference(s)

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

18GE0M3 MATHEMATICAL FINANCE AND QUEUEING THEORY

3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

Articulation Matrix

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

UNIT I **9 Hours**

APPLIED STOCHASTIC CALCULUS

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

UNIT II **9 Hours**

STATISTICS

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

UNIT III **9 Hours**

CONTINUOUS-TIME FINANCE

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

UNIT IV **9 Hours**

QUEUEING THEORY

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

UNIT V **9 Hours**

NON-MARKOVIAN QUEUES AND QUEUEING NETWORKS

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

Total: 45 Hours

Reference(s)

1. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.
2. S. Shreve, Stochastic Calculus for Finance, Vol. 1 and Vol. 2, Springer, 2004.
3. G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.
4. Taha, H.A., Operations Research, Pearson Education, Asia, 8th Edition, 2007.

18GE0E1 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

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						1	2		2					
4						1	2		2					
5						1	2		2					

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

18GE0E2 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promoting the product / services
- Handle the human resources and taxation
- Understand Government industrial policies / support provided and prepare a business plan

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

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

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.htm

18EC001 ANALOG VLSI DESIGN 3 0 0 3

Course Objectives

- To understand the basics of analog integrated circuits.
- To understand the basic building blocks like current sources, sinks and mirrors.
- To comprehend the performance metrics of amplifier circuits and design single stage amplifiers.
- To understand differential amplifier and common mode rejection ratio.
- To design operational amplifier and operational transconductance amplifier.

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.
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. Comprehend the MOSFET models at different frequencies.
2. Analyze and design current sources and voltage references for given specifications
3. Analyze and design single stage MOS amplifiers
4. Analyze CMOS differential amplifiers
5. Analyze and design CMOS operational amplifiers.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO ANALOG VLSI

Circuit Design consideration for MOS challenges in Analog Circuit Design, Recent Trends in Analog VLSI Circuits, Low Frequency MOSFET models, High Frequency MOSFET models, Temperature effects in MOSFET, Noise in MOSFET.

UNIT II **9 Hours**

CMOS SUBCIRCUITS

MOS Switch, MOS Diode/ Active Resistor, Simple Current Sinks and Sources, Basic Current Mirrors, Current and Voltage References, Bandgap References.

UNIT III **9 Hours**

CMOS AMPLIFIERS

Performance Metrics of amplifier circuits, Common Source Amplifier, Common Gate Amplifier, Cascode Amplifier, Frequency Response of Amplifiers, Stability of Amplifiers

UNIT IV **9 Hours**

CMOS DIFFERENTIAL AMPLIFIER

Differential Signalling, Source Coupled Pair, Current Source Load, Common Mode Rejection Ratio, CMOS Differential amplifier with Current Mirror Load, Differential to single ended Conversion.

UNIT V **9 Hours**

CMOS OPERATIONAL AMPLIFIER

Block Diagram of Op-Amplifier, Ideal characteristics of Op-Amplifier, Design of two stage Op_Amplifier, Compensation of Op-Amplifier, Frequency response of Op-Amplifier, Operational Transconductance Amplifier.

Total: 45 Hours

Text Book(s)

1. Behzad Razavi,Design of Analog CMOS Integrated Circuits, Second Edition, McGraw-Hill, 2000.
2. R. Jacob Baker, CMOS: Circuit Design , Layout and Simulation, , Third Edition, Wiley Publication, 2010.

Reference(s)

1. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, Analog Integrated Circuit Design,Second Edition, Wiley Publication,2011.
2. Behzad Razavi,Fundamentals of Microelectronics,Second Edition, Wiley Publication, 2013.
3. Phillip Allen, Douglas Holmberg,CMOS Analog Circuit Design, Second Edition,Oxford University Press, 2004.

18EC002 IC DESIGN FOR DSP 3 0 0 3

Course Objectives

- To familiarize the concept of DSP and DSP algorithms.
- Introduction to Multirate systems and finite word length effects.
- To know about the basic DSP processor architectures and the synthesis of the processing elements.

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 procedural flow of system design in DSP and Integrated circuit
2. Analyse the frequency response and transfer function of DSP systems
3. Analyse different architectures for DSP system.
4. Implement architectures for DSP system into hardware.
5. Analyze the synthesis processing elements.

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**

DSP INTEGARTED CIRCUITS AND VLSI CIRCUIT

Standard digital signal processors, Application specific IC for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.

UNIT II **9 Hours**

DIGITAL SIGNAL PROCESSING

Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signalprocessing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms.

UNIT III **9 Hours**

DSP ARCHITECTURES

DSP system architectures, Standard DSP architecture-Harvard and Modified Harvard architecture. Ideal DSP architectures, Multiprocessors and multi computers, Systolic and Wave front arrays, Shared memory architectures.

UNIT IV **9 Hours**

SYNTHESIS OF DSP ARCHITECTURES

Synthesis: Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit serial PEs. Combinational & sequential networks- Storage elements, clocking of synchronous systems, Asynchronous systems -FSM.

UNIT V **9 Hours**

ARITHMETIC UNIT AND PROCESSING ELEMENTS

Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Digit Serial arithmetic, CORDIC Algorithm, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator.

Total: 45 Hours

Reference(s)

1. Lars Wanhammer, DSP Integrated Circuits, 1999 Academic press, New York
2. A.V.Oppenheim et.al, Discrete-time Signal Processing, Pearson Education, third edition 2014.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital signal processing A practical approach, Second Edition, Pearson Education, Asia, 2002.
4. Keshab K.Parhi, "VLSI Digital Signal Processing Systems design and Implementation", John Wiley & Sons, 1999.
5. B.Venkatramani, M.Bhaskar, "Digital Signal Processors", Tata McGraw-Hill, 2002.
6. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2002.

18EC003 LOW POWER VLSI DESIGN 3 0 0 3

Course Objectives

- To understand different sources of power dissipation in CMOS.
- To perform power modelling and estimation of VLSI circuits at various levels of design abstractions.
- To compare the tradeoffs of CMOS circuits and devices based on leakage power.
- To design low power random access memories and arithmetic circuits.
- To understand the energy recovery techniques used in low power design.

Programme Outcomes (POs)

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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.
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. Analyze different sources of power dissipation in VLSI circuits
2. Apply the different techniques involved in low power adders and multipliers
3. Analyze leakage power reduction mechanism at device level and circuit level
4. Analyze the techniques involved in low power SRAM
5. Apply advanced and special techniques for reducing power consumption in memories

Articulation Matrix

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

UNIT I **9 Hours**

POWER DISSIPATION IN CMOS

Introduction to low power CMOS VLSI design-Need for low power VLSI chips-Charging and discharging capacitance-Short circuit current in CMOS circuit- Short circuit current of an inverter-short circuit current variation with output load-short circuit variation with input signal slope- CMOS leakage current-Static current Basic principles of low power design-Low power figure of merits.

UNIT II **9 Hours**

SIMULATION AND PROBABILISTIC POWER ANALYSIS

SPICE circuit simulation- Gate level logic simulation Architecture level analysis-Random logic signals Characterization of logic signals-continuous and discrete random signals-Probability and Frequency-Static Probability and frequency-conditional probability and frequency-word level and bit level statistics-Probabilistic power analysis techniques-Signal entropy.

UNIT III **9 Hours**

DESIGN OF LOW POWER CMOS CIRCUIT AND LOGIC LEVEL

Transistor and gate sizing-Sizing an inverter chain-transistor and gate sizing for dynamic power reduction-Equivalent pin ordering-Network reconstructuring and reorganization-Special Latches and Flip-flops-Low power digital cell library-Gate reorganization-Signal Gating-Logic Encoding.

UNIT IV **9 Hours**

LOW POWER STATIC RAM ARCHITECTURES

Introduction to SRAM-Organization of a static RAM-MOS static RAM memory cell-4T SRAM Architecture-6T SRAM Architecture- SRAM cell operation-Banked organization of SRAMs-Reducing voltage swings on bit lines-Reducing power in the write diver circuits-Reducing power in sense amplifier circuits.

UNIT V **9 Hours**

LOW POWER ARCHITECTURE AND ADVANCED TECHNIQUES

Power and performance management -Microprocessor sleep modes-performance management-adaptive filtering-Switching activity reduction-Parallel architecture with voltage reduction-Adiabatic computation-Pass transistor logic synthesis-Asynchronous circuits.

Total: 45 Hours

Text Book(s)

1. Gary Yeap, Practical Low Power Digital VLSI Design, Kluwer, 1997.
2. K.Roy and S.C. Prasad, Low Power CMOS VLSI Circuit Design, Wiley, 2000.

Reference(s)

1. K.S. Yeo and K.Roy, Low-Voltage, Low-Power VLSI Subsystems, Tata McGraw-Hill, 2004.
2. Dimitrios Soudris, Chirstian Pignet and Costas Goutis, Designing CMOS Circuits for Low Power, Kluwer, 2009.
3. James B. Kuo and Shin Chia Lin, Low voltage SOI CMOS VLSI Devices and Circuits, John Wiley and Sons, 2001.
4. J.B Kuo and J.H Lou, Low voltage CMOS VLSI Circuits, Wiley, 1999.

18EC004 VLSI VERIFICATION AND TESTING 3 0 0 3

Course Objectives

- To study the basic of VLSI Design flow and Synthesis.
- To apply low and high level optimization technique.
- To explore VLSI verification technique and testing

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 VLSI design flow, allocation and scheduling algorithms.
2. Determine the Logic synthesis of two level and multilevel synthesis
3. Apply Verification technique for VLSI circuit.
4. Analyze the concept of VLSI Testing.
5. Determine the test performance for combinational and sequential circuit

Articulation Matrix

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

UNIT I **9 Hours**

VLSI DESIGN FLOW AND SYNTHESIS

Introduction to Digital VLSI Design Flow, High Level Design Representation, Transformations for High Level Synthesis, Introduction to HLS: Scheduling, Allocation and Binding Problem, Scheduling Algorithms, Binding and Allocation Algorithms

UNIT II **9 Hours**

LOGIC OPTIMIZATION AND SYNTHESIS

Two level Boolean Logic Synthesis, Heuristic Minimization of Two-Level Circuits, Finite State Machine Synthesis, and Multilevel Implementation.

UNIT III **9 Hours**

VERIFICATION TECHNIQUES

Temporal Logic- Introduction to formal methods for verification, Temporal Logic: Introduction and Basic Operators, Syntax and Semantics of CTL, Equivalence between CTL Formulas, Binary Decision Diagram: Introduction and construction, Ordered Binary Decision Diagram, Operations on Ordered Binary Decision Diagram, Ordered Binary Decision Diagram for Sequential Circuits, Model Checking, Symbolic Model Checking,

UNIT IV **9 Hours**

TESTING OF VLSI CIRCUITS

Introduction to Digital VLSI Testing, Functional and Structural Testing, Fault Equivalence, Fault Simulation, Testability Measures (SCOAP).

UNIT V **9 Hours**

COMBINATIONAL AND SEQUENTIAL CIRCUIT TESTING:

Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras, D-Algorithm Sequential Circuit Testing and Scan Chains, ATPG for Synchronous Sequential Circuits, Scan Chain based Sequential Circuit Testing, Built in Self Test, Memory Testing

FURTHER READING

Verification and testing of Asynchronous and Synchronous sequential circuit, NOC and SOC.

Total: 45 Hours

Reference(s)

1. D. D. Gajski, N. D. Dutt,A.C.-H. Wu and S.Y.-L. Lin, High-Level Synthesis: Introduction to Chip and System Design,Springer, 1st edition, 1992.
2. S.Palnitkar,Verilog HDL:A Guide to Digital Design and Synthesis,Prentice Hall, 2nd edition, 2003.
3. G. De Micheli.Synthesis and optimization of digital circuits, 1st edition, 1994.
4. M. Huth and M. Ryan, Logic in Computer Science modeling and reasoning about systems, Cambridge University Press, 2nd Edition, 2004.
5. Bushnell and Agrawal,Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits,Kluwer Academic Publishers, 2000

18EC005 VLSI PHYSICAL DESIGN 3 0 0 3

Course Objectives

- To understand the concepts of VLSI Physical Design Automation
- To understand the concepts of Physical Design Process such as Partitioning, Floor planning, Placement and Routing
- To understand the concepts of Simulation and Synthesis in VLSI Design Automation

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 design methodologies for automation and floor planning
2. Analyze the physical design problems and Employ appropriate automation algorithms for placement and routing
3. Analyze the performance issues in circuit layout compaction
4. Classify the combinational logic synthesis techniques
5. Analyze the high level synthesis problems in assignment, scheduling and circuits using both analytical and CAD tools

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

UNIT I **9 Hours**

VLSI DESIGN AUTOMATION AND FLOOR PLANNING

Introduction to Design methodologies - VLSI physical design automation - Structural and logic design. Transistor level design. Layout design. Verification methods - Floor planning concepts -shape functions and floor plan sizing.

UNIT II **9 Hours**

PLACEMENT AND ROUTING

Placement and partitioning - Circuit representation - Placement algorithms ÃƒÂ¢?? partitioning algorithms - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

UNIT III **9 Hours**

LAYOUT COMPACTION AND PERFORMANCE ISSUES IN CIRCUIT LAYOUT

Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction- Delay models-Timing Driven Placement-Timing Driven Routing- Via Minimization -Power Minimization.

UNIT IV **9 Hours**

SINGLE LAYER ROUTING AND LOGIC SYNTHESIS

Simulation and logic synthesis- gate level and switch level modelling and simulation. Introduction to combinational logic synthesis. ROBDD principles, implementation, construction, and manipulation. Two level logic synthesis.

UNIT V **9 Hours**

HIGH LEVEL SYNTHESIS

High-level synthesis- hardware model for high level synthesis. Internal representation of input algorithms. Allocation, assignment and scheduling. Scheduling algorithms. Aspects of assignment. High level transformations

FOR FURTHER READING

Floor planning, Placement, and routing for VLSI circuits using backend tools

Total: 45 Hours

Reference(s)

1. H.Gerez, Algorithms for VLSI Design Automation, John Wiley & Sons, 2002
2. N.A Sherwani, Algorithms for VLSI Physical Design Automation, Kluwer Academic Publishers, 2002

3. Sarafzadeh, C.K. Wong, An Introduction to VLSI Physical Design, McGraw Hill International Edition 1995
4. R .Drechsler, Evolutionary Algorithms for VLSI CAD, Boston, Kluwer Academic Publishers, 2010
5. D.Hill, D.Shugard, J.Fishburn and K.Keutzer, Algorithms and Techniques for VLSI Layout Synthesis, Kluwer Academic Publishers, Boston, 1990

18EC006 WAVELET TRANSFORMS AND APPLICATIONS

3 0 0 3

Course Objectives

- Understand the basics of wavelet theory
- Illustrate the use of wavelet processing for data compression and noise suppression
- Analyse about wavelet packets

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.
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. Compare windowed Fourier transform and wavelet transform in the analysis of signals.
2. Analyse wavelet basis and characterize continuous and discrete wavelet transforms.
3. Design different filter banks and compute the discrete wavelet transform for multi rate digital filters.
4. Design of wavelets for given specifications and the application of wavelet transforms in the different fields.
5. Apply wavelets in filtering, compression , denoising, object detection and various other applications.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform,Time frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation,Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

UNIT II **9 Hours**

CONTINUOUS WAVELET TRANSFORM

Continuous wavelet transform (CWT),Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

UNIT III **9 Hours**

DISCRETE WAVELET TRANSFORM AND FILTERBANKS

Orthogonal and biorthogonal two-channel filter banks,Design of two-channel filter banks,Tree-structured filter banks Discrete wavelet transform, Non-linear approximation in the Wavelet domain, Multi resolution analysis,Construction and Computation of the discrete wavelet transform, The redundant discrete wavelet transform.

UNIT IV **8 Hours**

MULTI RESOLUTION ANALYSIS

Construction of an ortho-normal MRA, Wavelet basis for the MRA, Digital filtering interpretation, Examples of orthogonal basis generating wavelets, Interpreting ortho-normal MRA for discrete time signals, Generating scaling functions and wavelets from filter coefficients, Bi-orthogonal Wavelet bases, Filtering relationship for Bi-orthogonal filters, Bi-orthogonal scaling functions and wavelets, Two dimensional wavelets, Non separable Multi-dimensional wavelets, Wavelet Packets.

UNIT V **10 Hours**

APPLICATIONS

Audio and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, Transform coding and lossy transmission, Image fusion, Edge Detection and Object detection.

Total: 45 Hours

Reference(s)

1. Raghuveer M. Rao, Ajit S. Bopardikar, Wavelet Transforms: Introduction to theory and applications
2. K. P. Soman, K. I. Ramachandran, Insight Into Wavelets - From Theory to Practice, Prentice Hall of India, Eastern Economy Edition, Prentice Hall of India Private Limited, M-97, Connaught Circus, New Delhi - 110 001, Copyright 2004, ISBN Number 81-203-2650-4
3. Howard L. Resnikoff, Raymond O. Wells, Wavelet Analysis: The Scalable Structure of Information, Springer, 1998: available in Indian Edition
4. Michael W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer, ISBN 3-540-780-75-0, c 1999
5. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education

18EC007 VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- Design 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, 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.
n. 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.

18EC008 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, 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.
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. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 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. Identification of 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		1	1						2	3
2	2	3	1	1		1	1						3	3
3	2	1	3	1		1	1						3	2
4	2	2		3		1	1						3	2
5	3	2	2	3		1	1						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 Distancemeasures- 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- 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

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.

18EC009 VLSI DIGITAL SIGNAL PROCESSING 3 0 0 3

Course Objectives

- To understand the basic concepts of DSP algorithms
- To analyze the various pipelining and parallel processing techniques
- To analyze the retiming and unfolding algorithms for various DSP 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.
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. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 DSP architectures
2. Apply pipelining and parallel processing techniques for low power FIR and IIR filters
3. Apply the retiming, unfolding and folding algorithms for DSP applications
4. Apply the various convolution algorithms for DSP applications
5. Analyze the Bit-Level Arithmetic Architectures for multipliers

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

UNIT I **9 Hours**

INTRODUCTION TO DSP SYSTEMS

Introduction to DSP systems - Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm.

UNIT II **9 Hours**

PIPELINING AND PARALLEL PROCESSING OF FILTERS

FIR Filter Design, Pipelining of FIR filters, Parallel processing, Pipelining and Parallel processing for low power - IIR FILTERS design, Pipelined and parallel recursive filters

UNIT III **9 Hours**

RETIMING, UNFOLDING, FOLDING

Retiming - definitions and properties-Techniques, Unfolding - an algorithm for unfolding, properties of unfolding, Applications of unfolding: sample period reduction and parallel processing application. Relation - Critical path, unfolding and retiming. FOLDING: Introduction - folding Transformation - Register Minimization Techniques - Register Minimization in folded Architectures.

UNIT IV **9 Hours**

FAST CONVOLUTION

Fast convolution - Cook-Toom algorithm, modified Cook-Toom algorithm, Winogard, Modified Winogard, Iterated Convolution and cyclic convolution.

UNIT V **9 Hours**

BIT-LEVEL ARITHMETIC ARCHITECTURES

Bit-level arithmetic architectures - parallel multipliers with sign extension, Modified booth recoding, Lyon's bit-serial multipliers using Horner's rule, - CSD representation, CSD multiplication using Horner's rule

Total: 45 Hours

Reference(s)

1. Keshab K. Parhi, VLSI Digital Signal Processing Systems, Design and implementation, Wiley, Interscience, 2007.
2. U. Meyer-Baese, Digital Signal Processing with Field Programmable Gate Arrays, Springer, Second Edition, 2004.
3. S.Y. Kung, H.J. White House and T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985
4. Mohammed Isamail and Terri Fiez, Analog VLSI Signal and Information Processing, McGraw-Hill, 1994

18EC010 SPEECH SIGNAL PROCESSING 3 0 0 3

Course Objectives

- Analyse the speech signal in time domain and frequency domain.
- Design and apply various filters for speech signal processing.
- Understand the concept behind the various speech processing 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.
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. 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 speech signal models.
2. Apply various time domain models to extract speech parameters.
3. Design digital filters used for speech signal and analyze its spectral components.
4. Analyse LPC equations and apply for signal processing.
5. Apply the Speech Processing concepts for Man-Machine Communication.

Articulation Matrix

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

UNIT I **9 Hours**

SPEECH SIGNAL MODELS

Introduction: Speech Signal characteristics - Overview of Digital Speech Processing - Speech Production Mechanism - Acoustic Theory of Speech Production: Sound Propagation, Effects of Losses in Vocal Tract, Vocal Tract Transfer Function for Vowels, Sound Excitation in Vocal Tract-Lossless Tube Models: Wave Propagation, Boundary Conditions, Transfer functions, Sound Excitation in Vocal Tract - Digital Models for Speech Signal: Vocal Tract, Radiation, Excitation, Complete Model.

UNIT II **8 Hours**

TIME DOMAIN MODELS

Time Dependent Processing of Speech - Short Time Energy and Average Magnitude - Short time Zero Crossing Rate - Pitch Period Estimation - Short time Auto correlation Function - Median Smoothing.

UNIT III **8 Hours**

SHORT TIME FOURIER ANALYSIS

Definitions and Properties - Design of Digital Filter Banks: Filter design using IIR and FIR filters - Pitch Detection - Analysis-by-Synthesis - Homomorphic Speech Processing: Complex Cepstrum, Formant Estimation, Homomprphic Vocoder.

UNIT IV **10 Hours**

LINEAR PREDICTIVE CODING

Basic Principle - Solution of LPC equations: Cholesky decomposition method, Durbin"s method, Lattice formulation - Frequency domain interpretation of Linear Predictive Analysis - Relation between various Speech Parameters - Applications of LPC Applications: Pitch Detection, Formant Analysis, LPC Voder, Voice Excited LPC Vocoder.

UNIT V **10 Hours**

SPEECH PROCESSING FOR MAN-MACHINE COMMUNICATION

Voice Response Systems - Speaker Recognition Systems: Speaker Verification and Identification Systems - Speech Recognition Systems: Isolated Digit Recognition, Continuous Digit Recognition, Large Vocabulary Word Recognition System.

Total: 45 Hours

Reference(s)

1. Rabiner L R and Schaffer R W, Digital Processing of Speech Signals, Pearson Education - India, New Delhi, 2010.
2. Thomas F Quatieri, Discrete Time Speech Signal Processing, Pearson Education - India, New Delhi, 2011.
3. Owens FJ, Signal Processing of Speech, Macmillan, New York, 2013.
4. Rabiner L R and K Juang B H, Fundamentals of speech Recognition, Pearson Education - India, New Delhi, 2011.
5. John R Deller Jr and John H L Hansen, John G Proakis, Discrete Time Processing of Speech Signal, IEEE press, 2010.

18EC011 STATISTICAL SIGNAL PROCESSING 3 0 0 3

Course Objectives

- Understand the parametric and nonparametric approaches to power spectrum estimation techniques
- Differentiate the prominence of various spectral estimation
- Analyze the design and development of optimum filters using classical and adaptive algorithms

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.

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 efficient algorithms for estimation of various parameters of signals with different constraints
2. Outline various parametric estimation methods to accomplish the signal modeling even at higher order statistics
3. Formulate filtering problems from real life applications and design filtering solutions to estimate a desired signal from a given mixture by minimizing a cost function
4. Extrapolate the importance of least squares techniques and decomposition methods in analyzing the signal estimations
5. Analyse RLS equations and apply for signal processing

Articulation Matrix

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

UNIT I **9 Hours**

SPECTRAL ESTIMATION

Moving average (MA), autoregressive (AR), autoregressive moving average (ARMA),Estimated autocorrelation function, Nonparametric spectral estimation: periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram.

UNIT II **10 Hours**

PARAMETRIC SIGNAL MODELLING AND ESTIMATION

A review on random process. A review on filtering random processes, Examples, Maximum likelihood estimation, maximum a posteriori estimation, Cramer-Rao bound Pisarenko, MUSIC, ESPRIT, Higher order statistics.

UNIT III **8 Hours**

LINEAR ESTIMATION AND PREDICTION

The IIR Wiener Filter , Noncausal IIR Wiener Filter ,The Causal IIR Wiener Filter , Causal Wiener Filtering , Causal Linear Prediction , Wiener Deconvolution , Discrete Kalman Filter

UNIT IV **9 Hours**

LMS ALGORITHM AND APPLICATION

Block processing Versus Adaptive Processing , Introduction to LMS Algorithm, Adaptive filters based on steepest descent method , Proof Of Convergence Of Weight Vector , Mean Square Adjustment noise and convergence analysis , Application of Adaptive Noise Cancellation , Overview of adaptive lattice filtering

UNIT V **9 Hours**

RECURSIVE LINEAR MEAN SQUARED ESTIMATION

RLS algorithm, derivation, Matrix inversion Lemma, Initialization, tracking of nonstationarity-Estimation of a signal parameter - Estimation of time-varying signals- Kalman filtering - Filtering signals in noise - Treatment restricted to two variable case only - Simple problems.

Total: 45 Hours

Reference(s)

1. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons, Inc.,2002
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
3. J. G. Proakis et. al., Algorithms for Statistical Signal Processing, Pearson Education, 2002.
4. Simon Haykin: Adaptive Filter Theory, Prentice Hall, 1996
5. Srinath, Rajasekaran & Viswanathan, Introduction to statistical Signal processing with Applications, Prentice Hall of India, New Delhi - 110 001, 1999

18EC012 NEXT GENERATION NETWORKS 3 0 0 3

Course Objectives

- Understand the importance of Internet based Networks.
- Understand the importance of NGN Architectures and Functionalities

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.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. 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. Predict the importance and fundamentals of Internet based Networks.
2. Illustrate the functional and control NGN Architectures and its protocols.
3. Analyze the needs for next generation Broadband Internet and its performance.
4. Infer the NGN Service related Aspects.
5. Analyze the transition from existing networks to NGN.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction, Public Switched Telephone Network, Transmission Networks, Traditional Internet world, Internet Fundamentals by IETF.

UNIT II **9 Hours**

NGN STANDARDS AND ARCHITECTURES

Drivers to NGN, IP network concept for NGN, Functional architecture, Control Architecture and Protocols, Numbering, Naming and Addressing for NGN.

UNIT III **9 Hours**

BROADBAND INTERNET: THE BASIS FOR NGN

DSL, FTTH Access Networks, Next Generation Active and Passive Optical Networks,Metro Ethernet, Next Generation Mobile Networks, Quality of Service and Performance.

UNIT IV **9 Hours**

NGN SERVICE ASPECTS

IMS based Real Time Multimedia Service, Control & Signalling protocols for NGN, Security Mechanisms and Identity Management for NGN, Service Continuity, NGN Service Overlay Networks.

UNIT V **9 Hours**

TRANSITION TO NGN AND FUTURE EVOLUTION

Migration of PSTN to NGN, Transition of IP networks to NGN, Carrier Grade Open Environment, IPv6-Based NGN, Network Virtualization, Future Packet based Network, Web Services,VPN Services and IoT.

Total: 45 Hours

Reference(s)

1. Next Generation Networks Services, Technologies and Strategies, Neill Wilkinson, Wiley
2. Next Generation Network Services, Robet Wood, Pearson
3. Next-Generation Network Services: By Robert Wood, Published Nov 1, 2005 by Cisco Press.

18EC013 CRYPTOGRAPHY AND 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, 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.
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. Analyse various cryptography techniques and their implications on network security
2. Design the mathematical models required for cryptography.
3. Analyse the symmetric and Asymmetric cryptography Algorithms
4. Analyse the hash algorithms and key management techniques in network security
5. Classify the security protocols at transport and network layer.

Articulation Matrix

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

UNIT I **9 Hours**

NETWORK SECURITY CONCEPTS AND CLASSICAL ENCRYPTION TECHNIQUES

Security threats and attacks, Security services, Security mechanisms, Network security model - Substitutions techniques - Monoalphabetic ciphers, Polyalphabetic ciphers, Vernam- Transpositions techniques - Rail fence

UNIT II **9 Hours**

MATHEMATICS OF CRYPTOGRAPHY

Euclidean and Extended euclidean Algorithm- Modular arithmetic- addition & multiplication inverse- Fermat's and Euler Theorem- Algebraic structures- Groups, Rings, Fields- Finite field- GF(p)- GF(2n).

UNIT III **11 Hours**

CRYPTOGRAPHY ALGORITHMS

Modern Block ciphers - Components- Feistel cipher - Symmetric:DES - AES- Block Cipher Modes-ECB-CBC-CFB-OFB-Asymmetric key cryptography - Diffie Hellman Algorithm-RSA - Elliptic Curve Cryptography.

UNIT IV **8 Hours**

HASH ALGORITHM, KEY MANAGEMENT AND SECURITY AT THE APPLICATION LAYER

MD 5- SHA1 - Key Distribution- Digital Signatures- Authentication Protocol - Network Security Email-PGP-S/MIME.

UNIT V **8 Hours**

SECURITY AT TRANSPORT LAYER AND NETWORK LAYER

Transport layer-SSL Architecture & Protocols ,TLS -Network layer- IPSEC .

Total: 45 Hours

Reference(s)

1. Forouzan.B.A. and Mukhopadhyay.D, Cryptography and Network Security, Tata McGraw Hill, 2nd Edition, 2012
2. Atul Kahate "Cryptography and Network Security". Tata McGraw-Hill 5. Richard E. Smith,"Internet Cryptography", Addison- Wesley, 1997
3. William Stallings, "Cryptography and Network Security", Pearson Education, 7th Edition, New Delhi, 2018.
4. Alfred J. Menezes, Paul C.Van OorSchot, Scott A.Van Stone, "Handbook Of Applied Cryptography", CRC Press, 1996.
5. Bruce Schneier,"Applied Cryptography: Protocols, Algorithms, and Source Code in C",Second Edition, Wiley, John & Sons, Incorporated, October 1995.

18EC014 SATELLITE COMMUNICATION 3 0 0 3

Course Objectives

- The intention and purpose of the course is to know the basics of satellite communication
- The intention and purpose of the course is to understand the concepts of orbital mechanics, multiple access techniques and spacelinks
- The intention and purpose of the course is to gain knowledge on spacecraft subsystems, earth stations and satellite platform 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.
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. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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	2
2	2	3	2										2	2
3		2	3										2	2
4		2		3									2	2
5			2			1	2						2	2

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, Amplifier, Amplifier Noise Temperature, 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, LEO, MEO, Navigation System, Direct to Home service (DTH), Digital Audio Broadcast (DAB), 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

18EC015 NETWORK PROTOCOL ENGINEERING 3 0 0 3

Course Objectives

- To Understand the Concept of different Network Protocols
- To explore the Network Protocol Development Process and Implementation Technique

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.
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. Apply the connection and connection-less oriented Network Protocol Services and its Description.
2. Analyse the Performance of Communication Networking Protocols.
3. Apply the existing Description Method and techniques for suitable Protocol Development
4. Analyse the processing and verification techniques used for developing a Network Protocol.
5. Analyse Network Protocol Implementation and Testing techniques in Network Protocol design.

Articulation Matrix

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

UNIT I **9 Hours**

PRINCIPLES OF COMMUNICATION PROTOCOLS

Services: Principles, Models of Communication Service, Connection Oriented Service, Connection-less Service, Service Descriptions, XDT Service; Protocol: Principles, Specifications Examples; Layers: Principles, Description, Examples

UNIT II **9 Hours**

LAYERED ARCHITECTURE AND PROTOCOL FUNCTIONS

Open Architecture, Communication and Protocol Architecture, OSI Reference Model architecture, IEEE 802 LAN architecture, TCP/IP Protocol suite, Broadband ISDN model; Functions: Error control, Synchronization, Connection Management, PDU Coding/Decoding, Adjustment of size, Flow Control

UNIT III **9 Hours**

DESCRIPTION METHODS AND TECHNIQUES

Formal description methods:Specifications-cTLA Need of Description, Classifications, Finite State Machine (FSM), Extended Finite State Machines-SDL, Communication Oriented Description- MSC, Temporal Logic, Hybrid Methods, Algebraic Description-LOTOS.

UNIT IV **9 Hours**

DEVELOPMENT OF COMMUNICATION PROTOCOLS

Protocol development process: Development phases, Singularities of protocol development; Design: Systematic protocol design, Specification development; Verification: Verification techniques, Reachability analysis, Petri net analysis, Algebraic verification, Deductive verification, Model checking; Performance evaluation: Specification of non-functional aspects, Performance modelling techniques, Tools.

UNIT V **9 Hours**

IMPLEMENTATION AND TESTING

Protocol specification to implementation: Implementation models, Interface design, Example , Specific implementation issues, Automated protocol implementation; Testing: Types of protocol tests; Conformance test; Derivation of test cases; Interoperability test, Active vs. passive testing, TTCN-2, TTCN-3

Total: 45 Hours

Reference(s)

1. Hartmut Konig, Protocol Engineering, Springer, 2012
2. Miroslav Popovic, Communication Protocol Engineering, CRC Taylor& Francis, 2006

18EC016 DATA COMMUNICATION AND NETWORKS 3 0 0 3

Course Objectives

- To study and understand the basics of data communication networks.
- To get familiarize with the up-to-date developments in switching and network technology.
- To understand the techniques involved in Transport, presentation and application layers.

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.
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. Infer the basics of data communication networks.
2. Analyze the up-to-date developments in switching technology.
3. Apply the logical addressing and various routing protocols in the network layer for data transmission.
4. Analyze the techniques to improve QoS in the transport layer.
5. Apply the techniques involved in presentation and application layers.

Articulation Matrix

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

UNIT I **9 Hours**

PHYSICAL LAYER

Data Communications - Networks - Networks models - OSI model - Layers in OSI model - TCP / IP protocol suite - Addressing - Guided and Unguided Transmission media Switching: Circuit switched networks - Data gram Networks - Virtual circuit networks - Cable networks for Data transmission: Dialup modems - DSL - Cable TV for Data transfer.

UNIT II **9 Hours**

DATA LINK LAYER

Data link control: Framing - Flow and error control - Protocols for Noiseless and Noisy Channels - HDLC Multiple access: Random access - Controlled access - Wired LANS : Ethernet - IEEE standards - standard Ethernet - changes in the standard - Fast Ethernet - Gigabit Ethernet. Wireless LANS : IEEE 802.11-Bluetooth. Connecting LANS: Connecting devices - Backbone networks - Virtual LANS Virtual circuit networks: Architecture and Layers of Frame Relay and ATM.

UNIT III **9 Hours**

NETWORK LAYER

Logical addressing: IPv4, IPv6 addresses Internet Protocol: Internetworking - IPv4, IPv6 - address mapping - ARP, RARP, BOOTP, DHCP, ICMP, IGMP, Delivery - Forwarding - Routing - Unicast, Multicast routing protocols.

UNIT IV **9 Hours**

TRANSPORT LAYER

Process-to-Process delivery - User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) - Congestion Control - Quality of services (QoS) - Techniques to improve QoS.

UNIT V **9 Hours**

PRESENTATION AND APPLICATION LAYER

Domain Name System (DNS) - E-mail - FTP - WWW - HTTP - Security Services - Message Confidentiality - Message Integrity - Message Authentication - Digital Signature - Entity Authentication - Digitizing Audio and Video - Audio and Video Compression - Streaming Stored Audio/Video - Streaming Live Audio/Video - Real-Time Interactive Audio/Video - RTP - RTCP - Voice Over IP.

Total: 45 Hours

Reference(s)

1. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill,Fourth edition, July 2017.
2. William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2014.

3. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2010.

18EC017 ELECTRONIC PRODUCT DESIGN 3 0 0 3

Course Objectives

- To provide a clear understanding of the practical design problems of electronic products at an introductory level.
- To become familiar with the concept of product design, Portable Electronic design, Displays,Power sources.
- To gain practical experience in Electronic Product Design under the In-house product design scheme.

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 product design flow cycle in manufacturing.
2. Apply the design guidelines for DIP, Axial lead components
3. Design power supplies used in electronic products
4. Design computer aided Printed Circuit Boards.
5. Develop various Electronic Products for real time applications.

Articulation Matrix

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

UNIT I **9 Hours**

PRODUCT DESIGN FLOW

Product Development Basics: Cost Design Curve, Classification of Electronic Products, Product Development Cycle. Product Design By Plan : Project Organization, Plan Schedules, Project Design Constraints, Product Cost, Electronic Product Design Management, Product Design Issues, Product Design Management, Changing the Corporate Culture, Electronic Product Design Process, Design for manufacturing Automation, Component Selection, Product Evaluation.

UNIT II **9 Hours**

DESIGN GUIDELINES

Design Guidelines for DIP Components: Introduction, DIP components, High Performance DIP Inserter, Design Guidelines for Axial lead components : Introduction, Sequencing the components for Automatic Insertion, Surface Mount Technology : Description, Surface Mount Process flow, Printed Circuit Board, Solder Paste, Pick and Place Bake.

UNIT III **9 Hours**

DESIGN OF POWER SUPPLIES

DC power supply using transistors and SCRs-Design of crowbar and foldback protection circuits-Switched mode power supplies Forward flyback buck and boost converters - Design of transfo- -rmers and control circuits for SMPS.

UNIT IV **9 Hours**

DESIGN OF PRINTED CIRCUIT BOARDS

Technology of printed circuit boards (PCB) General layout rules and parameters,PCB design rules for Digital Circuits-High Frequency Analog Power Electronics and Microwave circuits, Computer Aided design of PCBs-Product Implementation.

UNIT V **9 Hours**

PRODUCT DEVELOPMENT

Development of UPS,Solar panel, Line follower,Robotic Arm,Cell phone and Portable PCs.

Total: 45 Hours

Reference(s)

1. Electronic Product Design for Automated Manufacturing by Richard Stillwell, Marcel Dekker Inc, Newyork and Ba
2. Portable Electronics Product Design and Development By Bert Haskell , McGraw Hill Professional, 2004
3. Electronic Product Design, R.G. Kaduskar, V.B.Baru,2ed ,Wiley-India
4. Designing Electronic Product Enclosures, by Tony Serksnis
5. Power Management in Mobile Devices: Communications Engineering Series
6. Handbook of Switched Mode Supplies by Keith H.Billings , McGraw-Hill Publishing Co., 1989

18EC018 EMBEDDED NETWORKS AND PROTOCOLS 3 0 0 3

Course Objectives

- Understand the fundamentals of embedded systems programming, real time operating systems.

- Develop a power aware protocols for networks of small devices.
- Explore newly established standards for embedded systems and ubiquitous computing.

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.
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.
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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 performance of embedded communication protocols
2. Analyze the different data communication strategies of USB and CAN bus
3. Identify the elements of a network and analyze its speed to select appropriate ethernet controllers for internet in local communication
4. Apply the existing layer technologies to develop a secure embedded network
5. Apply the different MAC strategies to develop an energy efficient routing algorithms for wireless embedded networks

Articulation Matrix

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

UNIT I **9 Hours**

EMBEDDED COMMUNICATION PROTOCOLS

Embedded Networking: Introduction- Serial/Parallel Communication- Serial Communication Protocols- RS232 Standard- RS485 Standard- Synchronous Serial Protocols- Serial Peripheral Interface (SPI)- Inter Integrated Circuits (I2C)- PC Parallel port Programming.

UNIT II **9 Hours**

USB AND CAN BUS

USB Bus Introduction- Speed Identification on the Bus- USB states- USB bus Communication: Packets- Data flow types- Enumeration- Descriptors- PIC 18 Microcontrollers, USB Interface- C Programs. CAN Bus Introduction- Frames- Bit Stuffing- Types of errors- Nominal Bit Timing- PIC microcontroller CAN Interface.

UNIT III **9 Hours**

ETHERNET BASICS

Elements of a network- Inside Ethernet- Building a Network: Hardware options- Cables, Connections and Network Speed- Design choices: Selection Components- Ethernet Controllers- Using the internet in local communications.

UNIT IV **9 Hours**

EMBEDDED ETHERNET

Exchanging messages using UDP and TCP- Serving web pages with Dynamic Data- Serving web pages that respond to user input- Using FTP- Keeping devices and network secure.

UNIT V **9 Hours**

WIRELESS EMBEDDED NETWORKING

WSN Introduction- Applications- Network Topology- Localization- Time Synchronization- Energy efficient MAC protocols- SMAC- Energy efficient and robust routing, ISA/PCI Bus protocols- Firewire- A simple application with CAN- Inside the Internet Protocol- E-mail for embedded systems- Data centric routing.

Total: 45 Hours

Text Book(s)

1. Frank, Vahid, Givargis, "Embedded Systems Design: A Unified Hardware/ Software Introduction, Wiley Publications, 2002.

Reference(s)

1. Jan Axelson, "Parallel Port Complete", Penram Publications, 2011.
2. Dogan Ibrahim, "Advanced PIC Microcontrollers Projects in C", Elsevier, 2008.
3. Jan Axelson, "Embedded Ethernet and Internet Complete", Penram Publications, 2005.
4. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge Press, 2005.

18EC019 REAL TIME OPERATING SYSTEMS 3 0 0 3

Course Objectives

- To understand the basics of operating systems tasks and basic OS architectures and develop these to RTOS
- To understand concepts of task scheduling
- To understand problems and issues related with multitasking
- To learn strategies to interface memory and I/O with RTOS kernels
- To impart skills necessary to develop software for embedded computer systems using a real-time operating system

Programme Outcomes (POs)

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

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

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.

n. 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 basics of operating systems tasks and basic OS architectures and develop the RTOS.
2. Classify the different task scheduling concepts in RTOS.
3. Analyze the problems and issues related with multitasking.
4. Predict strategies to interface memory and I/O with RTOS kernels
5. Develop software for embedded computer systems using a real-time operating system.

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

UNIT I **9 Hours**

INTRODUCTION TO RTOS

Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems,Architecture of OS (Monolithic, Microkernel, Layered, Exo-15 kernel and Hybrid kernel structures), Batch, Multi programming, Multitasking, Multi user, parallel, distributed & real time

UNIT II **9 Hours**

SCHEDULING

Uniprocessor Scheduling: Types of scheduling Scheduling algorithms: FCFS, SJF, Priority, Round RobinUNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept.

UNIT III **9 Hours**

CONCURRENCY

Concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing techniques Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategies

UNIT IV **9 Hours**

MEMORY

Memory Management requirements, Memory partitioning: Fixed, dynamic, partitioning Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging Page Replacement Policies (FIFO, LRU, Optimal, clock), Thrashing, Working Set Model

UNIT V **9 Hours**

INPUT AND OUTPUT MANAGEMENT

I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches

Total: 45 Hours

Reference(s)

1. C.M. Krishna and G.Shin, Real Time Systems, McGraw-Hill International Edition, 2017.
2. Jean J Labrosse, Embedded Systems Building Blocks Complete and Ready-to-use Modules in C, CMP books, 2/e, 1999.
3. Raj Kamal, "Embedded Systems Architecture Programming and Design", Second Edition,TMH, 2010
4. Jean J Labrosse , Micro C/OS-II, The Real Time Kernel, CMP Books, 2011
5. Sam Siewert, V, Real-Time Embedded Components and Systems: With Linux and RTOS (Engineering), 2015
6. Tanenbaum, Modern Operating Systems, 3/e, Pearson Edition, 2007.

18EC020 INTERNET OF THINGS 3 0 0 3

Course Objectives

- Understand the basic principles and architectures of IoT.
- Explain the physical design,logical design and their technologies.
- Explain the IoT communication principles and their protocols.
- Understand the Cloud Storage Models & Communication APIs.
- Explain the case studies with real time 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
n. 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. Infer the architecture, design principles of Internet of Things and M2M & IoT fundamentals
2. Analyze the design of Internet of Things.
3. Analyze the fundamental IoT protocols.
4. Analyze the cloud and cloud services in the context of IoT.
5. Apply/ Develop IoT infrastructure for real-time scenarios.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO IOT

Architectural Overview- Design Principles and needed capabilities- IoT applications- Sensing - Actuations -Basics of Networking - M2M and IoT Technology fundamentals -Devices and gateways - Data management- Business process in IoT- Everything as a Service(XaaS)- Role of cloud in IoT- Security aspects in IoT.

UNIT II **9 Hours**

DESIGN OF INTERNET OF THINGS

Design of Internet of Things: Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and Deployments, Introduction to Physical Devices and Endpoints.

UNIT III **9 Hours**

IOT COMMUNICATION PRINCIPLES

Internet Communication- IP addresses- MAC addresses- TCP and UDP Ports- Application Layer Protocols- IEEE 802.15.4: Physical layer- Media-Access Control Layer & Uses- MQTT Protocol - Zigbee - Bluetooth.

UNIT IV **9 Hours**

IOT PHYSICAL SERVERS

Introduction to Cloud Storage Models & Communication APIs - Public, Private and Hybrid cloud platforms - WAMP - AutoBahn for IoT - Xively Cloud for IoT - Amazon Web Services for IoT: Amazon EC2, Amazon AutoScaling, Amazon S3, Amazon RDS, Amazon DynamoDB, Amazon Kinesis, Amazon SQS, Amazon EMR- SkyNet IoT Messaging Platform.

UNIT V **9 Hours**

CASE STUDIES

Smart Lighting - Smart Parking - Weather Monitoring System - Air Pollution Monitoring - Smart Irrigation - IoT Printer.

Total: 45 Hours

Reference(s)

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things, A Hands on Approach, University Press.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
3. Peter Waher,Learning Internet of Things,Packt Publishing,UK, 2015.
4. Adrian McEwen, Hakim Cassimally ,Designing the Internet of Things, Wiley Publishing, 2015.
5. Dieter Uckelmann, Mark Harrison and Florian Michahelles, Architecting the Internet of Things, Springer, NewYork, 2011.
6. Raj Kamal, Internet of Things: Architecture and Design, McGraw Hill.

18EC021 WIRELESS SENSOR NETWORKS 3 0 0 3

Course Objectives

- To obtain a broad understanding of various challenges involved to design wireless sensor networks.
- To focus on network architecture and protocols of wireless sensor networks.
- To understand the recent technologies and applications of wireless sensor networks.

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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. Infer the fundamentals of wireless sensor networks and its applications in enabling technologies.
2. Analyze the architecture of wireless sensor network and its execution environment
3. Apply the MAC and routing protocols for wireless sensor networks and also the assignment of MAC Addresses.
4. Design wireless sensor networks with the role of topology control, synchronization and localization for various applications.
5. Predict the tools and platforms needed to establish sensor networks and its applications

Articulation Matrix

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

UNIT I **9 Hours**

OVERVIEW OF WIRELESS SENSOR NETWORKS

Key definitions of sensor networks, Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Advantages of sensor Networks, Applications of sensor networks- Enabling Technologies for Wireless Sensor Networks

UNIT II **9 Hours**

ARCHITECTURES

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, WSN Network architecture: typical network architectures-data relaying and aggregation strategies- Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT III **9 Hours**

NETWORKING OF SENSORS

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Issues in Designing a MAC protocol for wireless sensor network, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy Efficient Routing, Geographic Routing.

UNIT IV **9 Hours**

INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and positioning- properties-approaches-Single Hop localization, localization services, Sensor Tasking and Control.

UNIT V **9 Hours**

SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware - Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming, Applications Of WSN: WSN Applications -Home Control -Building Automation -Industrial Automation -Medical Applications -Reconfigurable Sensor Networks -Highway Monitoring -Military Applications.

Total: 45 Hours

Text Book(s)

1. Holger Karl,Andreas Willig,Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005
2. Feng Zhao,Leonidas J,J Guibas,Wireless Sensor Networks An Information Processing Approach,Elsevier, 2007

Reference(s)

1. Kazem Sohraby,Daniel Minoli,Taieb Znati,Wireless Sensor Networks-Technology,Protocols, And ApplicationsÃ¢??, John Wiley, 2007.
2. Anna Hac,Wireless Sensor Network Designs,John Wiley,2003
3. BhaskarKrishnamachari,Networking Wireless Sensors,Cambridge Press, 2005
4. Mohammad Ilyas and Imad Mahgaob,Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems, CRC Press, 2005

18EC022 ARM ARCHITECTURE AND PROGRAMMING

3 0 0 3

Course Objectives

- To understand the steps involved in the design of ARM processor and its architecture.
- To understand the ARM assembly language programming and its architectural support.
- To provide in-depth understanding of the memory hierarchy in ARM processor.

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.

n. 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 abstraction levels in the design of processor.
2. Analyze the ARM processor architectures and interfacing.
3. Apply the ARM and thumb instruction set for data transfer operations in processor.
4. Infer the architectural support for machine language.
5. Illustrate the memory hierarchy and management techniques for DSP and embedded applications.

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

UNIT I **7 Hours**

INTRODUCTION TO PROCESSOR DESIGN

Abstraction in hardware design- MUO - a simple processor - Processor Design trade off- Design for low power consumption.

UNIT II **10 Hours**

ARM ARCHITECTURE

Acorn RISC Machine - Architecture Inheritance - ARM Programming Model- ARM Development Tools - 3 and 5 Stage Pipeline ARM Organization - ARM Instruction Execution and Implementation - ARM Co-Processor Interface-ARM Bus Architectures.

UNIT III **10 Hours**

ARM ASEEMBLY LANGUAGE PROGRAMMING

ARM Instruction Types - Data Transfer, Data Processing and Control Flow Instructions - ARM Instruction Set - Co-Processor Instructions. Thumb Instruction set.

UNIT IV **9 Hours**

ARCHITECTURAL SUPPORT FOR HIGH LEVEL LANGAUGE

Data Types - Abstraction in software Design - Expressions - Loops - Functions and Procedures - Conditional Statements - Use of Memory.

UNIT V **9 Hours**

MEMORY HIERARCHY AND MANAGEMENT

Memory Size and Speed - On Chip Memory - Caches - Cache Design - an Example- Memory management. An Introduction to Operating Systems - ARM System Control Coprocessor- CP15 Protection Unit Registers - ARM Protection Unit - CP15 MMU Registers - ARM MMU Architecture - Synchronization - Context Switching Input and Output. DSP and Embedded Applications.

Total: 45 Hours

Reference(s)

1. Steve Furber, ARM System on Chip Architecture, Addison- Wesley Professional Second Edition, Aug 2000.
2. Andrew N Sloss, Dominic Symes, Chris Wright,ARM System Developers Guide , Designing and Optimizing System Software, Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, Design of System on a Chip: Devices and Components, Springer First Edition, July 2004.
4. Jason Andrews, Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), Newnes, BK and CD-ROM (Aug 2004).
5. Rashinkar P, Paterson and Singh L, System on a Chip Verification Methodologies and Techniques, Kluwer Academic Publishers, 2001.

18EC023 FUZZY SYSTEMS AND APPLICATIONS 3 0 0 3

Course Objectives

- Understand fuzzy logic basics ,operations, fuzzy arithmetic, representations and classical logic.
- To introduce the various learning rules, Fuzzy relations and Fuzzy aggregations
- To explain the solutions of a problem by Fuzzy Logic method based on linguistic inputs.
- To explain the concept of Fuzzy rule based models .
- To explain few applications of Fuzzy Logic in different 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.
n. 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 different types of operations and properties of fuzzy sets.
2. Infer the fuzzy relations in building intelligent machines.
3. Apply Fuzzy Logic clustering and classification methods to handle uncertainty and solve engineering problems.
4. Analyze fuzzification and defuzzification methods for solving real time problems.
5. Apply fuzzy membership function and rules for real time engineering problems.

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

UNIT I **9 Hours**

FUZZY SETS

Basic Types & Basic Concepts - alpha-cuts - Additional Properties of alpha - Cuts - Representations of Fuzzy Sets - Extension Principle for Fuzzy Sets - Basic Concepts of Fuzzy Numbers -Types of Operations -Fuzzy Complements - t-Norms (Fuzzy Intersections) -t-Co-norms (Fuzzy Unions) - Combinations of Operations.

UNIT II **9 Hours**

FUZZY RELATIONS

Essential Elements of Fuzzy Systems - Classical Inference Rule - Classical Implications and Fuzzy Implications - Crisp Versus Fuzzy Relations - Projections and Cylindrical Extensions - Binary Fuzzy Relations - Fuzzy Compatibility Relations - Fuzzy Equivalence Relations.

UNIT III **9 Hours**

FUZZY CLASSIFICATION

Classification by Fuzzy Equivalence Relations - Cluster Analysis - Cluster Validity - C-means Clustering - Hard C-Means , Fuzzy C-Means - Hardening the Fuzzy C-Partitions - Similarity Relations from Clustering.

UNIT IV **9 Hours**

FUZZIFICATION AND DEFUZZIFICATION

Concept of fuzzification Defuzzification Methods : Maximum membership principle - Centroid method - Weighted average method - Mean max membership - Center of sums Center of largest area, first (or last) of maxima.

UNIT V **9 Hours**

FUZZY LOGIC II (FUZZY MEMBERSHIP, RULES)

Membership functions - interference in fuzzy logic - fuzzy if-then rules - Fuzzy implications and Fuzzy algorithms - Fuzzy Controller - Applications : Fuzzy washing machine - Fuzzy traffic regulations - Fuzzy logic control of drives, P, PI and PID.

Total: 45 Hours

Reference(s)

1. Klir, G.J. & Yuan,B.- Fuzzy sets and Fuzzy logic, theory and applications, Prentice Hall of India Private Limited.2010.
2. Timoty Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 2009
3. George J.Klir and Bo Yuan,Fuzzy Sets and Fuzzy Logi, Prentice Hall of India, New Delhi, 2004.

4. Timothy J.Ross,Fuzzy Logic with Engineering Applications, second edition, John Wiley & Sons Pvt. Ltd, 2005.
5. G. J. Klir and T. A. Folger, Fuzzy Sets Uncertainty and Information, PHI IEEE, 1995.
6. M. Ganesh, Introduction to fuzzy sets and fuzzy logic, PHI.2002.

18EC024 MACHINE LEARNING TECHNIQUES 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, 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.
n. 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 **8 Hours**

INTRODUCTION

Introduction-Definitions, types of learning, designing learning systems, issues in machine learning, - hypothesis space and inductive bias, evaluation, cross-validation.

UNIT II **9 Hours**

SUPERVISED LEARNING

Regression-Linear and multilinear regression, polynomial, decision trees, random forest. Classification- k-nearest neighbor algorithm, Classification and Regression Tree, logistic regression.

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

18EC025 ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS

3 0 0 3

Course Objectives

- To study the concepts of biological and artificial neurons.
- To explore the fundamentals of various algorithms related to supervised neural networks and its applications.
- To explore the Applications of various algorithms related Genetic algorithms and SVM.

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.
n. 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 network learning rules to create models using Artificial Neural Networks.
2. Apply BPN and BAM networks for real world problems.
3. Analyze the counter propagation, self organizing maps and ART networks and their applications.
4. Analyze the encoding, selection techniques and fitness function of genetic algorithms.
5. Apply ANN in signal and Medical image analysis.

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTAL CONCEPTS AND MODELS OF ARTIFICIAL NEURAL SYSTEMS

Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II **9 Hours**

BPN AND BAM

Back Propagation Network, Generalised Delta Rule, BPN Application, Associative Memory Definition, BAM, Hop field Memory, Simulated Annealing-Boltzmann Machine.

UNIT III **9 Hours**

OTHER NETWORKS

Counter Propagation Network, Feature Mapping, Self Organising Feature Maps, Adaptive Resonance Theory (ART) Network-Spatio-temporal neural networks Descriptions and applications.

UNIT IV **9 Hours**

GENETIC ALGORITHMS

The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling.

UNIT V **9 Hours**

ADVANCES AND APPLICATIONS

Support Vector Machines, RBF Network, Neocognitron Evolving neural networks using GA, Applications of ANN in signal analysis and Medical image analysis.

Total: 45 Hours

Reference(s)

1. Sathish Kumar, Neural networks-A Class Room approach, third edition, Tata Mc Graw Hill New Delhi, 2012.
2. James Freeman A. and David Skapura M., Neural Networks - Algorithms, Applications & Programming Techniques Addison Wesley, 1992.
3. Yegnanarayana B., Artificial Neural Networks, Prentice Hall of India Private Ltd., New Delhi, 1999.
4. Laurence Fausett, Fundamentals of Neural Networks: Architecture, Algorithms and Applications, Prentice Hall, 1994
5. Simon Haykin, Neural Networks: A Comprehensive Foundation, 2nd Edition,Prentice Hall India,2002.
6. Philip D.Wasermann, Advanced Methods in neural Computing, Van Nostrand Reinhold,NewYork 1993.

18EC026 INDUSTRIAL AUTOMATION 3 0 0 3

Course Objectives

- Understand the architecture of Industrial Automation System
- Analyze the architecture of the basic Measurement, Data Acquisition and Process Control Subsystems
- Analyze the advanced Control Systems used for Industrial Automation

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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. Infer the Architecture of the Industrial Automation System and need for Automation
2. Analyze the characteristics of Measurement, Data Acquisition, and Control Sub systems
3. Analyze the operation and hardware environment of sequence control in Industrial Automation using PLC
4. Analyze the typical Control Methods used in Industry to solve complex engineering problems
5. Analyze the recent developments in the Industrial Automation

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

UNIT I **9 Hours**

INTRODUCTION TO INDUSTRIAL AUTOMATION

Introduction to Industrial Automation, Need for Industrial Automation, Real World Examples, Architecture of Industrial Automation Systems

UNIT II **9 Hours**

DATA AQUISITION AND PROCESS CONTROL

Measurement System Characteristics in Industrial Automation, Data Acquisition Systems, Introduction to Automatic Control, PID Control and PID Control Tuning, Feed forward Control, Time Delay Systems and Inverse Response Systems, Special Control Structures.

UNIT III **9 Hours**

SEQUENCE CONTROL

Introduction to Sequence Control, PLC , RLL- Sequence Control. Scan Cycle, Simple RLL Programs- A Structured Design Approach to Sequence Control-PLC Hardware Environment

UNIT IV **9 Hours**

INDUSTRIAL CONTROL SYSTEMS

Flow Control Valves, Hydraulic Control Systems, Industrial Hydraulic Circuit, Pneumatic Control Systems, Energy Savings with Variable Speed Drives, Introduction to CNC Machines

UNIT V **9 Hours**

ADVANCED TOPICS

The Fieldbus Network, Higher Level Automation Systems

Total: 45 Hours

Reference(s)

1. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House, 2013
2. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India, 2012
3. Electric Motor Drives, Modelling, Analysis and Control, R. Krishnan, Prentice Hall India, 2002
4. Hydraulic Control Systems, Herbert E. Merritt, Wiley, 1991

18EC027 DEEP LEARNING TECHNIQUES 3 0 0 3

Course Objectives

- Understand the operation of Deep Learning Neural Networks
- Understand the Architecture of Deep Learning Artificial Neural Networks
- Analyze the real world applications of Deep Learning ANN

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.
n. 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. Infer the mathematical background and significance of Machine Learning Principles.
2. Apply the mathematical background and significance of Artificial Neural Networks in Deep Learning.
3. Analyze the operation of ANN for Deep Learning
4. Analyze the Supervised and Unsupervised models of ANN for Deep Learning
5. Analyze the recent developments and real world examples of Deep Learning Networks.

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

UNIT I **9 Hours**

INTRODUCTION TO MACHINE LEARNING

Overview of machine learning, linear classifiers, loss functions, Stochastic gradient descent and contemporary variants, back-propagation.

UNIT II **9 Hours**

INTRODUCTION TO NEURAL NETWORKS

Activation functions, initialization, regularization, batch normalization, model selection, ensembles, Fundamentals, architectures, pooling, visualization.

UNIT III **10 Hours**

NEURAL NETWORK IN ACTION

Transposed convolution, efficient pooling, object detection, semantic segmentation, Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, video processing, learning from descriptions, attention

UNIT IV **9 Hours**

DEEP GENERATIVE MODELS

Auto-encoders, variational auto-encoders, generative adversarial networks, autoregressive models, generative image models, unsupervised and self-supervised representation learning

UNIT V **8 Hours**

DEEP REINFORCEMENT LEARNING

Policy gradient methods, Q-Learning, Real World Applications of Deep Learning Techniques

Total: 45 Hours

Reference(s)

1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.

2. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

18EC028 PATTERN RECOGNITION 3 0 0 3

Course Objectives

- To understand different supervised and unsupervised learning techniques
- To obtain sound knowledge in the recent advancement on pattern recognition 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.
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.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 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	1	1						2	1	2
2	3	2	3	1	1	1						2	1	2
3	2	1	2	1	1	1						1	1	2
4	3	2	3	1	1	1						2	1	2
5	3	1	3	1	2	1						2	1	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.

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.

18EC029 COMPUTER ARCHITECTURE 3 0 0 3

Course Objectives

- To conceptualize the basics of organizational and architectural issues of a digital computer.
- To analyze performance issues in processor and memory design of a digital computer.
- To understand various data transfer techniques in digital computer.

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.

Course Outcomes (COs)

1. Explain the evolution and concepts of computing systems.
2. Implement the various data path components of computing systems.
3. Implement the various control logic components of computing systems.
4. Apply the concepts of instruction level parallelism in computer organization.
5. Analyze the performance of memory and input / output organization.

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 **9 Hours**

OVERVIEW

Eight ideas - Components of a computer system - Technology - Performance - Power wall -Uniprocessors to multiprocessors; Instructions- operations and operands - representing instructions - Logical operations - control operations Addressing and addressing modes.

UNIT II **7 Hours**

DATA PATH DESIGN

Basic MIPS implementation -Building datapath -Control Implementation scheme - Pipelining-Pipelined datapath and control Handling Data hazards & Control hazards Exceptions.

UNIT III **11 Hours**

ARITHMETIC OPERATIONS

ALU - Addition and subtraction -Multiplication - Division -Floating Point operations - Subword parallelism.

UNIT IV **9 Hours**

PARALLELISM

Instruction-level-parallelism Parallel processing challenges Flynn"s classification - Hardware multithreading Multicore processors.

UNIT V **9 Hours**

MEMORY AND I/O SYSTEMS

Memory hierarchy - Memory technologies Cache basics Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/OM processors.

Total: 45 Hours

Reference(s)

1. David A. Patterson and John L. Hennessey, Computer Organization and Design,Fifth edition, Morgan Kauffman / Elsevier, 2014.
2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, Computer Organisation, VI edition, Mc Graw-Hill Inc, 2012.
3. William Stallings Computer Organization and architecture, Seventh Edition, Pearson Education, 2006.
4. Vincent P. Heuring, Harry F. Jordan, Computer System Architecture, Second Edition, Pearson Education, 2005.
5. Govindarajalu, Ã¢??Computer Architecture and Organization, Design Principles and Applications", first edition, Tata Mc Graw Hill, New Delhi, 2005.
6. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 1998.

18EC030 AUTOMOTIVE ELECTRONICS AND NETWORKING

3 0 0 3

Course Objectives

- To gain the basic knowledge about automotive systems
- To study the characteristics of automotive sensors and actuators
- To understand the fundamentals of automotive networking in new generation vehicles

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.
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. Apply the fundamentals and concept of electronics in automotive industry.
2. Analyze the functionalities of automotive sensors
3. Analyze the concepts of automotive actuators in modern vehicles.
4. Apply the basic knowledge of electronics in vehicular architecture
5. Asses the most suitable networking topologies for a new generation automotive systems.

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										2	
4	2		3										2	
5	1	2											2	

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 travelled 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.

Total: 45 Hours

Reference(s)

1. Konrad Reif -Automotive Mechatronics_ Automotive Networking, Driving Stability Systems, Electronics-Vieweg-Teubner Verlag (2015)
2. Najamuz Zaman (auth.)-Automotive Electronics Design Fundamentals-Springer International Publishing (2015)
3. Robert Bosch GmbH, Bosch Automotive Electrics and Automotive Electronics_ Systems and Components, Networking and Hybrid Drive-Springer Vieweg (2014)
4. William Ribbens-Understanding Automotive Electronics, Fifth Edition-Newnes (1998)
5. W.H.Crouse ,Automobile Electrical Equipment, McGraw-Hill, 1996.
6. P.L.Kholi, Automotive Electrical Equipment, Tata McGraw-Hill, 1995

18EC031 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, 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. 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	1										
2	3	2	3	1										
3	2	2	1	2										
4	3	1	1	2										
5	1	3	3	1										

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, cardiacoutput, 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 equipmentPatient monitoring system.

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.

18EC032 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, 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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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.

18EC033 NANO ELECTRONICS 3 0 0 3

Course Objectives

- To study the channel and gate effect of MOS system
- To understandnanotube FETs and MOSFETs
- To study the recent trends of nano devices in the industry

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.
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 broadest 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.
n. 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 basic concepts of nanotechnology
2. Illustrate the basic concepts of nanotechnology
3. Demonstrate the concept of Silicon MOSFET and quantum transport devices
4. Analyse the process involved in carbon nanotubes
5. Analyse the concept of 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; MolecularNanotechnology: Electron microscope-scanning electron microscope-atomic force microscope-scanning tunneling microscope-nano manipulator-nano tweezers-atom manipulation-nanodots; Top down and bottom up approaches: self assembly-dip pen nano lithography. Nanomaterials: preparation-plasma arcing-chemical vapor deposition-sol-gels-electrodeposition ballmilling

UNIT II **9 Hours**

FUNDAMENTALS OF NANOELECTRONICS

Fundamentals of logic devices:-Requirements-dynamic properties-threshold gates; physicallimits to computations; concepts of logic devices:-classifications-two terminal devices-fieldeffect devices-coulomb blockade devices-spintronics-quantum dot cellular automata-quantum computing-DNA computer, Ultimate computation:-power dissipation limit-dissipation in reversible computation.

UNIT III **9 Hours**

SILICON MOSFETS

Silicon MOSFETS-Novel materials and alternate concepts:-fundamentals of MOSFETDevices-scaling rules-silicon-dioxide based gate dielectrics-metal gates-junctions & contacts-advanced MOSFET concepts. Quantum transport devices based on resonant tunneling:-Electrontunneling-resonant tunneling diodes-resonant tunneling devices; Single electron devices forlogic 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-carbonnanotube 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 ofMEMS/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 BurkhardRaguse, 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 ElectronicMaterials andNovel Devices, Wiley-VCH, 2012
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

18EC034 LIQUID CRYSTALS AND APPLICATIONS 3 0 0 3

Course Objectives

- To acquire basic knowledge about liquid crystals
- To understand the concept of theories of liquid crystals
- To design and analyze the properties of liquid crystals from the theories

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.
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.

Course Outcomes (COs)

1. Explain the properties of liquid crystals.
2. Analyze the properties and parameters of Smectic C* phase.
3. Relate the properties exhibited by liquid crystals with the theories.
4. Illustrate the debye`s diffusive theory with its equations and applications.
5. Design, synthesis and characterize the liquid crystals for application utility.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO LIQUID CRYSTALS

Mesophase, Disordered Crystal Mesophase, Ordered fluid Mesophase, Types of liquid crystals, Lyotropic liquid crystals. Classification according to molecular order, Nematic order, Cholesteric order, Smectic order, polymorphism in thermotropic liquid crystals.

UNIT II **9 Hours**

FERROELECTRIC LIQUID CRYSTALS

Smectic C* phase and its ferroelectric properties, ferroelectricity in liquid crystals and smectic C* phase. Electro-optic preliminaries. The helicoidal C* structure, thermodynamic parameters of the smectic C* phase. Electro-optic properties, switching dynamics. Liquid crystal ferroelectrics versus solid ferroelectrics.

UNIT III **9 Hours**

THEORIES OF LIQUID CRYSTALS

Optical properties, Propagation along optic axis for wave lengths pitch. Darwin`s dynamical theory of X-ray diffraction. Mauguin-Oseen, De-vries model, equivalence of the Continuum and dynamical theories. Oblique incidence, propagation normal to the optic axis. Leslie`s theory of mechanical coupling, the Lehmann rotation phenomenon.

UNIT IV **9 Hours**

DIELECTRIC DISPERSION

Representation of permittivity in complex plane, Debye`s semicircle. Debye equations, Cole-Cole arc. Cole-Davidson arc. Debye diffusion theory of relaxation. Application of debye`s diffusive theory.

UNIT V **9 Hours**

APPLICATIONS OF LIQUID CRYSTALS

Liquid crystal displays-Electro-optic effects and Addressing Techniques. Electro-optic phenomena, Field induced birefringence, twisted nematic effects. Guest-Host effect, Cholesteric to nematic transition, Dynamic scattering, Storage mode.

Total: 45 Hours

Reference(s)

1. DeGennes and Prost, The Physics of Liquid Crystals, Clarendon Press, 1995
2. S Chandrasekhar, Liquid Crystals, Cambridge University Press, 1992
3. Sandep Kumar, Liquid crystal dimers, Cambridge University Press, 2017

18EC035 MEMS 3 0 0 3

Course Objectives

- To understand the operation of major classes of MEMS devices and systems
- To understand the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands, environments and applications of MEMS 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.
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. 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 operation of micro devices, micro systems and their applications
2. Design the micro devices, micro systems using the MEMS fabrication process
3. Analyze typical materials used for fabrication of micro systems
4. Apply the principles of standard micro fabrication techniques in manufacturing.
5. Analyze the challenges in the design and fabrication of Micro systems.

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

UNIT I **9 Hours**

INTRODUCTION TO MICROSYSTEMS

Overview of MEMS and Microsystems technology - Characteristics of MEMS materials - Laws of scaling - Multi-disciplinary nature of MEMS - Survey of materials central to micro engineering - Applications of MEMS in various industries - RF MEMS, BioMEMS, MOEMS, NEMS.

UNIT II **9 Hours**

MICRO SENSORS AND ACTUATORS

Working principle of Microsystems - micro actuation techniques - micro sensors - types - micro actuators - types - micropump - micromotors - microvalves - microgrippers - micro accelerometers.

UNIT III **9 Hours**

FABRICATION PROCESS

Substrates - single crystal silicon wafer formation - Photolithography - Ion implantation - Diffusion - Oxidation - CVD - Physical vapor deposition - Deposition epitaxy - etching process.

UNIT IV **9 Hours**

MICROMACHINING

Overview of micro manufacturing - Bulk micro manufacturing, Surface micro machining, LIGA - SLIGA - Micro system packaging materials - die level - device level - system level - packaging techniques - die preparation - surface bonding - wire bonding - sealing.

UNIT V **9 Hours**

MICROSYSTEMS DESIGN AND PACKAGING

Design considerations - Mechanical Design, Process design, Realization of MEMS components - Micro system packaging technologies - Assembly of Microsystems - Reliability in MEMS.

Total: 45 Hours

Reference(s)

1. Chang Liu, Foundations of MEMS, Pearson, 2012.
2. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, TMH, 2002.
3. Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000.
4. Stephen D. Senturia, Microsystem design, Springer (India), 2006.
5. Mark Madou, Fundamentals of Micro fabrication, CRC Press, New York, 1997.
6. Julian W Gardner, Microsensors: Principles and Applications, John Wiley & Sons, 1994.

18EC036 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 principle of working and applications of CRO and other electronic measuring devices
- To learn the graphical programming palettes and tools in virtual instrumentation

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.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 electronic instrumentation concepts for the measurement of electrical quantities
2. Illustrate the different selection aspects and working principle of transducers
3. Recognize the different features of function generators and wave analyzers
4. Design different virtual instruments using LabView software

5. Identify the importance of data acquisition systems and communicate its principles and design aspects

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.

Total: 45 Hours

Reference(s)

1. 1. Ernest, Doeblin, Dhanesh and N.Manik, Measurement Systems- Application and Design, Tata McGraw-Hill, 2007
2. 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. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI, 2010
5. Sanjay Gupta, Virtual Instrumentation, LABVIEW, Tata McGraw-Hill, 2003.
6. Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, PHI, 2003

18EC037 DIGITAL IMAGE PROCESSING 3 0 0 3

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, 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.
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.
n. 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 image using image transforms.
2. Develop a methodology for smoothening and sharpening of the image.
3. Segment. the image using edge detection, thresholding and region based approach.
4. Develop a method to restore the image and object recognition
5. Compress the image using lossy and lossless compression techniques.

Articulation Matrix

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

UNIT I **9 Hours**

DIGITAL IMAGE FUNDAMENTALS

Fundamentals of Image processing: 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

Spatial domain: Histogram processing, Equalization, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters,Frequency Domain: Image smoothing and sharpening using frequency domain filters.

UNIT III **9 Hours**

IMAGE SEGMENTATION

Edge detection: 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 splitting and Region Merging

UNIT IV **9 Hours**

IMAGE RESTORATION AND RECOGNITION

Image Restoration: 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.

UNIT V **9 Hours**

IMAGE COMPRESSION

Basic compression methods-Huffman coding, Golomb coding, Arithmetic coding, LZWcoding, Run-length coding, Lossless and Lossy predictive coding, Block transform coding, Waveletcoding

Total: 45 Hours

Reference(s)

1. Digital Image Processing, C.Rafeal Gonzalez and E.Richard Woods, Pearson Education,Third Edition, 2008
2. Fundamentals of Digital Image Processing, Anil K.Jain,PHI, 2010.
3. Digital Image Processing , S Jayaraman, S Esakkirajan T Veerakumar, Mc Graw-Hill, 2010.
4. Digital Image Processing, K.William Pratt, John Wiley, 1997.
5. Image Processing Theory, Algorithm and Architectures, M.A.Sid Ahmed,McGraw-Hill, 1995.

18EC038 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. Apply the concepts of Electronics and Communication in the design of application oriented engineering systems.
n. Implement the state-of-the-art technologies in Micro/Nano electronics, Signal/Image processing, VLSI/ Embedded and Wired/Wireless communication systems.
o. Solve the 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- fMRI.

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.

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.

18EC039 BIO SIGNAL PROCESSING 3 0 0 3

Course Objectives

- Understand the various biomedical signal characteristics, analysis and spectrum estimation.
- Understand the various ways of removing artifacts, pattern classification and diagnostic decision of bio signals.
- To learn the applications of wavelets and chaos theory on bio signals.

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.
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.
n. Able to disseminate ideas and create new avenues in the field of signal processing.

Course Outcomes (COs)

1. Analyze the various forms of bio signal waveforms and its characteristics.
2. Analyze the bio signals using time series and estimate its spectrum by applying different methods.
3. Apply various filtering methods for removing artifacts in bio signals.
4. Apply different classification and decision algorithms on bio signals.
5. Apply the wavelets and chaos theory and also methods used for compression of those signals.

Articulation Matrix

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

UNIT I **9 Hours**

BIO SIGNAL WAVE SHAPES AND WAVEFORM COMPLEXITY

Introduction to Biomedical signals-overview and characteristics of ECG, ENG, EMG, EEG, ERPs, EGG, PCG, Carotid pulse and EOG SIGNALS, Analysis of ECG-Envelope extraction and analysis of PCG-Correlation and Cross spectral analysis of EEG Channels.

UNIT II **9 Hours**

TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION

Time series analysis-linear prediction models-Time variant systems- Adaptive segmentation-Spectral Estimation-Blackman Tuckey method-Periodogram and model based estimation.

UNIT III **9 Hours**

REMOVAL OF ARTIFACTS

Noise sources in biomedical signals-Review of optimal filtering-adaptive filters- LMS&RLS Adaptive filters-Removal of Artifacts in ECG-Maternal-Fetal ECG-Muscle contraction interference-use of adaptive filters for segmentation in ECG and PCG Signals.

UNIT IV **9 Hours**

BIO SIGNAL PATTERN CLASSIFICATION AND DIAGNOSTIC DECISION

Pattern classification as applied to Bio signals-supervised pattern classification-unsupervised pattern classification-Probabilistic models and statistical training and test steps-Neural networks-measures of diagnostic accuracy and cost-Reliability of classifiers and decisions.

UNIT V **9 Hours**

SPECIAL TOPICS ON BIO SIGNAL PROCESSING

Application of wavelet transform-TFR representation-ECG Characterization- wavelet networks-data compression of ECG and EEG signals-Application of chaos theory on Bio signals.

Total: 45 Hours

Reference(s)

1. Rangaraj.M.Rangayyan, Biomedical Signal Analysis-A Case Study Approach,IEEE Press- John Wiley&Sons Inc, New York-2002.
2. D.C.Reddy, Biomedical Signal Processing Principles and Techniques, TATA McGraw-Hill Education, New Delhi, 2009.
3. Arnon-Cohen, Bio-Medical Signal Processing, Vol I&II, CRC Press.1995.
4. W.J.Tompkins, Biomedical Digital signal processing, Prentice Hall, New Jersey-1993.
5. IEEE Transaction on Bio Medical Engineering.
6. IEEE Engineering Medicine and Biology Magazine.

18EC0YA BASICS OF ANALOG AND DIGITAL ELECTRONICS

3 0 0 3

Course Objectives

- Understand the working of diodes and transistors in electronic circuits.
- Understand the analog operational amplifier and its applications.
- Understand the implementation of combinational and sequential circuits in digital systems.

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.
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. Apply the diodes and transistors in regulators and amplifiers and analyze their characteristics.
2. Illustrate the working of analog IC with different configurations and its applications.
3. Simplification of Boolean expressions using K-map and implementation of combinational circuits.
4. Analyze the Flip flops and memory configurations in digital circuits.
5. Classify and analyze A/D and D/A converters with its parameters.

Articulation Matrix

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

UNIT I **9 Hours**

SEMICONDUCTORS DEVICES

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram - Mobility - Electrons and holes - The P-N junction diode - Zener diode - Avalanche effect- Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier. PNP and NPN Bipolar junction Transistors - H parameters equivalent circuit - Common

emitter amplifier - DC behavior: the load slope and the Q point - AC behavior - Emitter follower amplifier - Field effect transistors: JFET and MOSFET.

UNIT II **9 Hours**

OPERATIONAL AMPLIFIERS: DC PERFORMANCE

The operational amplifier - Input resistance, Output resistance, Open loop gain - Bias currents - Offset currents - Offset voltage - Differential mode gain - Common mode gain - Common mode rejection ratio - Negative feedback - Open loop gain and closed loop gain - Inverter amplifier - Non-inverter amplifier - The voltage follower - Transimpedance amplifier (Current to voltage converter) - Differential amplifier. Adders, Subtractors, Comparator, Integrator and Differentiator.

UNIT III **9 Hours**

DIGITAL TECHNIQUES : COMBINATIONAL CIRCUITS

Numbering systems - Binary, octal and hexadecimal numbers - Boole algebra - Conversion and operations - AND gate- OR gate - Inverter - NAND gate - NOR gate - Exclusive OR gate. Morgans laws. Combinational Circuits: Truth tables, logic expressions, Logic simplification using K- map, , half and full adder/subtractor, multiplexers, demultiplexers, Logic families :TTL and CMOS.

UNIT IV **9 Hours**

DIGITAL TECHNIQUES: SEQUENCIAL CIRCUITS

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Flip Flop Conversion. Shift registers, Counters. Memories Structure: address and data bus. ROM, PROM, EPROM and flash RAM. Volatiles Memories: RAM, SRAM, DRAM. Addressing modes.

UNIT V **9 Hours**

DIGITAL TO ANALOG CONVERTERS AND ANALOG TO DIGITAL CONVERTERS

DIGITAL TO ANALOG CONVERTERS : Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network.Pulse Width Modulation . Resolution. Accuracy. Linearity. Zero Offset. Settling Time.Glitches. ANALOG TO DIGITAL CONVERTERS: Sampling. Real time sampling and equivalent time sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion.

Total: 45 Hours

Reference(s)

1. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education,2012.
2. J Millman, C. Halkias & Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw-Hill,2010.
3. Ramakant A.Gayakwad, OP-AMP and Linear IC"s , Prentice Hall of India, 2002.
4. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
6. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

18EC0YB 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, 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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 AND 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. W Judge, Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992.
4. P.L.Kholi, Automotive Electrical Equipment, Tata McGraw-Hill, 1995
5. Robert Bosch Automotive Hand Book, SAE, 2000.

18EC0YC PCB DESIGN AND PROTOTYPING 3 0 0 3

Course Objectives

- Understand the electronic components involved in PCB design
- Design a circuit schematic and PCB layout

- Prototype the concepts and analyze the manufacturing, assembly and testing principles

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.
m. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
n. 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 electronic components involved in PCB design
2. Design a circuit schematic using electronic components
3. Design a PCB layout and realize the manufacturing data
4. Develop a prototype model and understand the PCB manufacturing process
5. Analyse the PCB assembly, soldering and testing process

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

UNIT I **6 Hours**

ELECTRONIC COMPONENTS OVERVIEW

Current - Voltage - Voltage Sources - Series and Parallel - Electronic Components : Resistors, Capacitors, Inductor, Diode, Zener Diode, Transistor, FET, SCR, Relay, LED, Sensors,LDR, Thermistors, ICs and Packages - Mounting Technologies: Through Hole and SMD - Voltage Regulator - Bread board - Dot Board

UNIT II **6 Hours**

BASICS OF PCB

Necessity and Advantages of PCB - Classification of PCB - Classes of PCB Design - PCB Laminates - Terminologies in PCB - PCB Design Process CAD /CAM Operation - Industry Standard PCB Design

Tools - Reading Drawings and Diagrams - Schematic symbols for common electronic components - Symbol Properties - Reference Designators

UNIT III **6 Hours**

LAYOUT PLANNING AND DESIGN

General PCB Consideration - Mechanical and Electrical Design Consideration - Component Placement Rules - Conductor Orientation , Routing and spacing - Holes and Solder PAD - Automatic routers for PCB design - Layout Design Check list - DRC - Gerber File - PCB Design Check List - CAM Editing

UNIT IV **6 Hours**

PCB PROTOTYPING AND MANUFACTURING

Developing a Prototype - Developing a Timeline - Developing a Budget - Developing a Production Schedule - Chemical and Mechanical Operation: Single Layer, Double Layer and Multilayer PCB Board Manufacturing Process - PCB Defects

UNIT V **6 Hours**

ASSEMBLY, SOLDERING AND AQL

PCB Assembly Process - Soldering Material, Tool & Types - Common Soldering faults - Desoldering Techniques - Quality Assurance - Testing of PCB - Acceptance Criteria

FURTHER READING

HDI - Solder mask - Silk screen printing - Signal Integrity - EMI/EMC - Flexible PCBs - ESD

UNIT VII **15 Hours**

LAB COMPONENT

1.Simulation of Series & Parallel Circuits. 2.Power Supply Board Design and Prototyping. 3.Automatic Street Light Board Design and Prototyping. 4.Dancing LED Board Design and Prototyping.

Total: 45 Hours

Reference(s)

1. R.S. Khadhapur, Printed Circuit Boards: Design, Fabrication and Assembly , McGraw Hill Companies, Electronic Engineering, 2006.
2. Sd.Mehta, Electronic Product Design Vol. 1 Basics of PCB Design, S Chand & Company Pvt. Ltd, 2011.
3. Earl Gates, Introduction to Basic Electricity and Electronics Technology, Delmar Cengage Learning, 2013.
4. Kraig Mitzner, Complete PCB Design using OrCAD Capture and Layout, Newnes, 2007.
5. Clyde F. Coombs, Printed Circuits Handbook, McGraw Hill, Sixth Edition, 2008.

18EC0YD MICROCONTROLLER PROGRAMMING 3 0 0 3

Course Objectives

- Understand Series of Microcontrollers in terms of architecture, Programming and Interfacing.
- Learn Programming of PIC series of microcontrollers and learn building of hardware circuits using PIC 16F series of Microcontrollers
- Learn the emerging trends in the design of advanced Microncontrollers.

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.

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.

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. Interpret the components and functionalities of 8051 Microcontrollers.
2. Develop microprocessor applications using Assembly Language Program
3. Illustrate the working nature of PIC microcontroller on various versions
4. Illustrate the interfacing of different peripherals using PIC Microcontroller
5. Analyze the architecture and instruction set of ARM Microcontroller

Articulation Matrix

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

UNIT I **9 Hours**

8-BIT MICROCONTROLLER

Introduction-Intel 8051 architecture-Counters and Timers-Serial Interface- Interrupts- Interfacing to external memory and 8255- Instruction set- Address modes.

UNIT II **9 Hours**

8051 ALP AND APPLICATIONS

Assembly language program- Timers and Counters programming- DAC- ADC- Sensor- Keyboard and LCD.

UNIT III **9 Hours**

PIC MICROCONTROLLER

PIC Microcontroller features- PIC Architecture, Program Memory, Addressing Modes, Instruction Set, Instruction Format- Byte-oriented Instructions- Bit-oriented Instructions- Literal Instructions- Control Instructions (CALL & GOTO)- Destination Designator. MPLAB overview: Using MPLAB, Toolbars, Select Development Mode and Device type, Project, Text Editor, Assembler, MPLAB operations.

UNIT IV **9 Hours**

PIC HARDWARE

Reset, Clock, Control registers, Register banks, Program Memory Paging, Ports, Interrupts, Timer and Counter, Watchdog Timer, Power up timer, Sleep mode, I2C bus- A/D converter.

UNIT V **9 Hours**

HIGH PERFORMANCE RISC ARCHITECTURE

ARM: The ARM architecture- ARM organization and implementation- The ARM instruction set- The THUMB instruction set- Basic ARM Assembly Language Program- ARM CPU Cores.

FOR FURTHER READING

Introduction- Architecture- Registers- Memory- Instruction set- Addressing Modes- I/O Pins- Timers- Counters- Interrupts.

Total: 45 Hours

Text Book(s)

1. Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 3rd Edition, 2004.

Reference(s)

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems", Person Education, 2nd Edition, 2004.
2. John B.Peatman, "Design with Microcontrollers", Person Education", 1st Edition, 2004.
3. Steave Furber, "ARM system-on-chip architecture" Addison Wesley, 2nd Edition, 2000.
4. A.V.Deshmukh, "Microcontrollers: Theory and Applications", Tata Mc Graw Hill, 12th reprint, 2005.

18EC0YE ENGINEERING COMPUTATION WITH MATLAB

3 0 0 3

Course Objectives

- The students for this course are expected to know basics of linear algebra and calculus. These are covered in Introductory Math course(s) for Engineers (typically done in first year).
- This is intended to be practical (laboratory) course. Likewise, students who have either completed or are currently doing Numerical Methods,Computational Techniques will find it easier to follow this course.
- Engineering Interpretations Of Real Time Mathematical Problems

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.

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.

Course Outcomes (COs)

1. Infer the basic procedural programming concepts
2. Apply the basic object oriented programming concepts.
3. Apply the modern computational tool for solving equations.
4. Develop experience in error analysis of engineering problems.
5. Design solution to an engineering problem using a software tool.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO MATLAB PROGRAMMING

Basics of MATLAB programming,Array operations in MATLAB, Loops and execution control Working with files: Scripts and Functions Plotting and program output.Approximations and Errors:Defining errors and precision in numerical methods, Truncation and round-off errors,Error propagation, Global and local truncation errors.

UNIT II **9 Hours**

NUMERICAL DIFFERENTIATION IN SINGLE VARIABLE

Numerical differentiation: Higher derivatives, Differentiation in multiple variables,Newton-Cotes integration formulae, Multi-step application of Trapezoidal rule,MATLAB functions for integration.Linear algebra in MATLAB: Gauss Elimination, LU decomposition and partial pivoting, Iterative methods: Gauss Siedel, Special Matrices: Tri-diagonal matrix algorithm.

UNIT III **9 Hours**

NONLINEAR EQUATIONS IN SINGLE VARIABLE

MATLAB function fzero in single variable,Fixed-point iteration in single variable, Newton-Raphson in single variable, MATLAB function fsolve in single and multiple variables, Newton-Raphson in multiple variables.Regression and Interpolation Introduction, Linear least squares regression(including lsqcurvefit function),Functional and nonlinear regression (including lsqnonlin function), Interpolation in MATLAB using spline and pchip.

UNIT IV **9 Hours**

ORDINARY DIFFERENTIAL EQUATIONS (ODE)

Introduction to ODEs; Implicit and explicit Eulers methods, Second-Order Runge-Kutta Methods MATLAB ode45 algorithm in single variable, Higher order Runge-Kutta methods,Error analysis of Runge-Kutta method.

UNIT V **9 Hours**

ORDINARY DIFFERENTIAL EQUATIONS (ODE) PRACTICAL ASPECTS

MATLAB ode45 algorithm in multiple variables, Stiff ODEs and MATLAB ode15s algorithm, Practical example for ODE-IVP, Solving transient PDE using Method of Lines.

Total: 45 Hours

Reference(s)

1. David M Smith,Engineering Computation with MATLAB,2012,Pearson
2. Cesar perezlopez,MATLAB Programming for Numerical Analysis,2014,Apress
3. Fausett L.V.,Applied Numerical Analysis Using MATLAB,2nd Ed,2007,Pearson Education,
4. Numerical Methods for Engineers,Chapra S.C. and Canale R.P. , McGraw Hill,5th Ed.,2006

18EC0YF BASICS OF HARDWARE DESCRIPTION LANGUAGES

3 0 0 3

Course Objectives

- To understand the digital logics
- To model the digital logics using Verilog HDL
- To understand the FPGA fundamentals, design and implementation of circuits

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.
n. 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 digital logics
2. Analyze the programmable IC technologies
3. Design a digital logic using Verilog HDL
4. Design a digital logic using advanced Verilog HDL and verify using test bench
5. Design a digital system using Verilog HDL

Articulation Matrix

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

UNIT I **9 Hours**

DIGITAL LOGIC

Number system, Boolean theorem, logic gates, Simplification of logic function, Combinational circuits- Adder, subtractor, Encoder, decoder, multiplexer, demultiplexer. Sequential circuits- latch, flip-flop, counter.

UNIT II **9 Hours**

PROGRAMMABLE DIGITAL ICS

Introduction to VLSI - Evolution of VLSI Systems - Applications of VLSI Systems - Programmable Logic Devices - ROM, PAL, PLA - CPLD- Introduction to FPGA - Digital IC design flow

UNIT III **9 Hours**

VERILOG HDL

Introduction to HDL - Lexical Conventions - Ports and Modules - Data Types - Data Flow Modeling - Operators - Gate Level Modeling

UNIT IV **9 Hours**

ADVANCED VERILOG HDL

Behavioural level Modelling - Synthesis of Finite State Machines- Switch Level Modelling- System Tasks & Compiler Directives - Test benches

UNIT V **9 Hours**

SYSTEM DESIGN USING VERILOG HDL

Design of Combinational circuits -Multiplexers / Demultiplexers, Magnitude comparators, Adders - Multiplier- Divider. Design of Sequential circuits - Flip flops,Registers / Shift registers, counters - State machines -Pattern sequence detector design.

Total: 45 Hours

Reference(s)

1. M.Morris Mano, Michael D Ciletti, Digital Design, 4th edition Pearson, 2011
2. Samir Palnitkar,Verilog HDL, Pearson Education, 2nd Edition, 2004.
3. Stephen Brown and Zvonko Vranesic,Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Tata McGraw Hill, 2014
4. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002
5. Ion Grout, Digital Systems Design with FPGAs and CPLDs, Elsevier, 2008
6. Ming-Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, 2012

18EC0YG FUNDAMENTALS OF EMBEDDED SYSTEMS **3 0 0 3**

Course Objectives

- To study the overview of Embedded System Architecture
- To learn the programming in Embedded System
- To learn various embedded communication protocols.

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.
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. Infer the hardware and software architectures of various Embedded Systems.
2. Apply the Programming concepts in Embedded systems.
3. Implement programs using ARM processor.
4. Apply various Embedded communication protocols.
5. Analyze real time operations in RTOS using various schedulers.

Articulation Matrix

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

UNIT I **9 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 **9 Hours**

PROGRAMMING CONCEPTS AND EMBEDDED PROGRAMMING IN C ,C

Software programming in Assembly language and in High level Language- 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 **9 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 **9 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 **9 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 - Ãƒ??Ãƒ?Ã‚µCOS.

Total: 45 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 Developers Guide Designing and Optimizing System SoftwareÃƒÂ¢??, Morgan Kaufmann Publishers, Elsevier, 2004.
6. MicroC/OS-II: The Real-Time Kernel by Jean J. Labrosse.

18EC0YH PRINCIPLES OF COMMUNICATION SYSTEMS

3 0 0 3

Course Objectives

- To study the various analog and digital modulation techniques
- To study the various digital communication techniques
- To enumerate the idea of spread spectrum modulation
- To study the design concepts of satellite and optical communication

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.
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. Illustrate the process involved in Amplitude, Frequency and phase modulation systems.
2. Analyze the performance of different digital modulation /demodulation techniques.
3. Analyze Pulse Code Modulation scheme for the transmission of analog data in digital format.
4. Apply the concepts of spread spectrum modulation techniques to eradicate interference in wireless communication.
5. Analyze the system design of satellite and optical communication.

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

UNIT I **9 Hours**

FUNDAMENTALS OF ANALOG COMMUNICATION

Principles of amplitude modulation, AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM Voltage distribution, AM power distribution, Angle modulation. FM andPM waveforms, phase deviation and modulation index, frequency deviation and percent modulation,Frequency analysis of angle modulated waves. Bandwidth requirements for Angle modulated waves

UNIT II **9 Hours**

DIGITAL COMMUNICATION

Introduction, Shannon limit for information capacity, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Minimum Shift Keying (MSK),Phase Shift Keying (PSK), BPSK, QPSK, 8 PSK Quadrature Amplitude Modulation (QAM), Bandwidth Efficiency,Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

UNIT III **9 Hours**

DIGITAL TRANSMISSION

Introduction, Pulse modulation, PCM , PCM sampling, sampling rate, signal to quantization noise rate,companding, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission, Intersymbol interference, eye patterns.

UNIT IV **9 Hours**

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques, wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

UNIT V **9 Hours**

SATELLITE AND OPTICALCOMMUNICATION

Satellite Communication Systems-Keplers Law,LEO and GEO Orbits, footprint, Link model-OpticalCommunication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.

FOR FURTHER READING

RADAR Communication: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar.

Total: 45 Hours

Reference(s)

1. Wayne Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson Education, 2007.
2. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons., 2001.
3. H.Taub,D L Schilling,G Saha ,Principles of Communication,3/e,2007.
4. B.P.Lathi,Modern Analog And Digital Communication systems, 3/e, Oxford University Press, 2007
5. Dennis Roddy, "Satellite Communications", Third Edition, Mc Graw Hill International Editions, 2001.
6. Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 4th edition., 2011.

18EC0YI ELECTRONIC PRODUCT DESIGN AND PACKAGING

3 0 0 3

Course Objectives

- To enhance the knowledge and skills of students in packaging of electronic systems.

- The students will achieve the knowledge about the manufacturing of printed circuit boards and product design methodologies.

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.
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. Apply the packaging hierarchy of electronic systems.
2. Design and manufacturing of printed circuit boards.
3. Analyze the component packages available for a given application
4. Apply the PCB assembly and soldering techniques.
5. Design of product ergonomics and aesthetics.

Articulation Matrix

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

UNIT I **9 Hours**

PACKAGING OF ELECTRONIC SYSTEMS

Electronic systems and needs. Physical integration of circuits, packages, boards and full electronic systems, Connectivity in Electronic equipment, Study of Electronic components and its packaging. Package classifications(Through hole and SMDs) and packaging trends. Standards of packaging, Packaging hierarchy of Electronic Products and Systems, Hierarchy of Interconnection Levels.

UNIT II **9 Hours**

MANUFACTURING AND DESIGN OF SECOND LEVEL (PCB) BOARDS AND FABRICATION METHOD

Evolutions of Printed Circuit Boards, Classification of Printed Circuit Boards(Single Sided PC Boards, Double Sided PC Boards, Multilayer PC Boards) ,Challenges in Modern PCB Design and Manufacture, Major Market Drivers for PCB Industry , PCB for Electronic Systems. PCB design considerations/ design rules for analog, digital and power applications.

UNIT III **9 Hours**

ELECTROMAGNETIC COMPATIBILITY

Electromagnetic interference in electronic systems and its impact, Analysis of electronic circuit from noise emission point of view (both conducted and radiated emission) cross talk and reflection. Design rules to overcome EMI.

UNIT IV **9 Hours**

THERMAL DESIGN OF CHIPS AND BOARDS

Thermal management of electronic devices and systems, Overview. Thermal interface material. Heat density in electronic components, Heat transfer through conduction, convection and radiation, Heat sinks, Principle, Construction and materials. Performance, Method of cooling, Heat pipes, Peltier cooling plates. Synthetic jet air cooling, Electrostatic fluid acceleration. Recent developments, Application in Electronics Systems, Personal Computers, Batteries and Soldering.

UNIT V **9 Hours**

INDUSTRIAL DESIGN OF ELECTRONIC PRODUCTS

Fundamentals of Industrial Design, Industrial Design Process - Investigation of customer needs, Conceptualization, Preliminary refinement, Further refinement and final concept selection, Ergonomics, Aesthetics-Colour, Form, Type, Concurrent Engineering, Physical Design of Packaging Standards, Materials, Manufacturing, Rapid Prototyping.

FOR FURTHER READING

EMI and EMC Simulation and Analysis,Porosity sealing or impregnation, Hybrid integrated circuits, Surface-mount technology ,Interposer, proximity communication, WSI (wafer-scale integration), Three-dimensional integrated circuits.

Total: 45 Hours

Reference(s)

1. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, NY, 2001.
2. William D. Brown, Advanced Electronic Packaging, IEEE Press, 1999.

18EC0YJ PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS

3 0 0 3

Course Objectives

- To understand the concept of data communication and networking models.
- To study the various networking Components and Networks.
- To explore the routing, addressing and security and management aspects of computer networks.

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.
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. Classify the types of computer networks and analyze the seven layers of OSI model.
2. Analyze the basic operations of Routing Algorithms and Routing devices
3. Analyze the local and wide area networking technologies.
4. Apply the ISDN and ATM interface connections in broadband networks.
5. Analyze the security and management techniques related with networks.

Articulation Matrix

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

UNIT I **9 Hours**

NETWORK FUNDAMENTALS

Types of Computer Networks: by Area, by Topology ; Communication Services: Serial and Parallel, Synchronous and Asynchrounous, Simplex and Duplex, Analog and Digital; Speed and Capacity; Multiplexing and Switching; Network Architecture: OSI Seven-Layer Network model.

UNIT II **9 Hours**

INTERNETWORKING AND COMPONENTS

Routing Concepts: Routing Algorithms, RIP, RIP-2, OSPF and other routing Protocols; Switches and Hubs: Store and Forward Switch, Cut-Through Switch,Hybrid Switch, Performance of Switches ; Repeaters; Repeater Vs Hubs; Bridges: Standards, Bridges Vs Repeaters; Routers and Gateways.

UNIT III **9 Hours**

LOCAL AND WIDE AREA NETWORKING TECHNOLOGIES

LAN Components and Topologies; Access Techniques; Transmission Protocols and Media; Ethernet and IEEE 802.3 Networks: History, 10-MBPS Ethernet, Switched Ethernet, 100-MBPS Ethernet, Gigabit Ethernet.

UNIT IV **9 Hours**

BROADBAND NETWORKS

ISDN: Evolution, ISDN Channel and Interface Structures; Broadband ISDN: Basics, Principles and General Architecture; Asynchronous Transfer Mode(ATM): Introduction, Concepts, Components,

Connection Supported by ATM network and Concept of Virtual Channel and Virtual Path, Traffic control and Congestion Control, Operation and Maintenance aspects.

UNIT V **9 Hours**

NETWORK SECURITY AND MANAGEMENT

Security: Need of Security, Security Threats, Vulnerabilities, Methods, tools and Techniques for Attacks; Network Security: Levels of Security, Cryptosystems; Data Encryption Standard (DES), Public Key Cryptography, Firewalls; Network Management: Functions and Elements, Distribution of Management; Simple Network Management Protocol (SNMP), Remote Network Management Services.

Total: 45 Hours

Reference(s)

1. Michael A.Gallo, William M. Hancock, Computer Communications and Networking Technologies, 1 Ed, Thomson Learning, 2002.
2. Kenneth C. Mansfield, Jr.James L. Antonakos, An Introduction to Computer Networking, 1Ed, Prentice Hall of India, 2002
3. A Shanmugam, S Rajeev, Computer Communication Networks, 1Ed, ISTE Learning Materials Centre, 2001
4. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall
5. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY

18GE0XA ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

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. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

Articulation Matrix

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

UNIT I **7 Hours**

CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

Articulation Matrix

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

UNIT I **15 Hours**

GENERAL PSYCOLOGY

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

Reference(s)

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 Delhi: Tata McGraw Hill. 1993

18GE0XC NEURO BEHAVIORAL SCIENCE 1 0 0 1

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

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

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

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

UNIT I **15 Hours**

ART OF FILMMAKING

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

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

Articulation Matrix

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

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga , History of Yoga - Yoga in todays scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - MudrasRelaxation - Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

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

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Programme Outcomes (POs)

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

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

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

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

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness.

Articulation Matrix

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

UNIT I **5 Hours**

FITNESS

Meaning & Definition, Need & importance of Physical fitness, Types Physical fitness - Exercise, Training and Conditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition; Principles of practicing;Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our healthand environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

Articulation Matrix

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

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

18GE0XI BLOG WRITING 1 0 0 1

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

Articulation Matrix

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

UNIT I **7 Hours**

UNIT I

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

UNIT II

Voice: Defining and achieving voice. Exploring various voices. Stylistic tipsÃƒÂ¢??rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1 0 0 1

Course Objectives

- Understand the role of National Service Scheme in community
- Identify the needs and problems of the community and involve in problem solving
- Develop competence required for group living and acquire leadership qualities

Programme Outcomes (POs)
Course Outcomes (COs)

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

Articulation Matrix

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

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure - roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, DayCamps-Basisofadoption of village/slums-Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies-Maintenance oftheDiary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009.

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

Articulation Matrix

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

UNIT I **12 Hours**

NCC STRUCTURE AND TRAINING

NCC ORGANIZATION

National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets. DRILL AND WEAPON TRAINING Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons.NATIONAL INTEGRATION AND SOCIAL AWARENESS National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP : Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader.

DISASTER MANAGEMENT AND FIRST AID Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 20 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)

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

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

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

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

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

Articulation Matrix

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

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVPPositioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategiesand Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Business stripped bare, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups.

Articulation Matrix

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

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

Creativity linked innovation - Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? - Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company''s capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly - Application of disruptive theories to complex problems and opportunities.

Total: 15 Hours

Reference(s)

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

Total: 15 Hours

Reference(s)

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7th Ed.New Dehi:Tata McGraw Hill.

18GE0XP FM RADIO BROADCASTING TECHNOLOGY

1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording.
2. Examine the available options for telephony interfaces for radio.

3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

Articulation Matrix

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

UNIT I **3 Hours**

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio- Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR-policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio.

UNIT III **3 Hours**

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V **3 Hours**

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup- Radio audience -measurements systems.

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGE Publications India, 2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Sean O Siochru, Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation, University of Michigan Press, 2008.
4. www.floridasound.com

5. www.mediacollege.com
6. www.mediacollege.com