



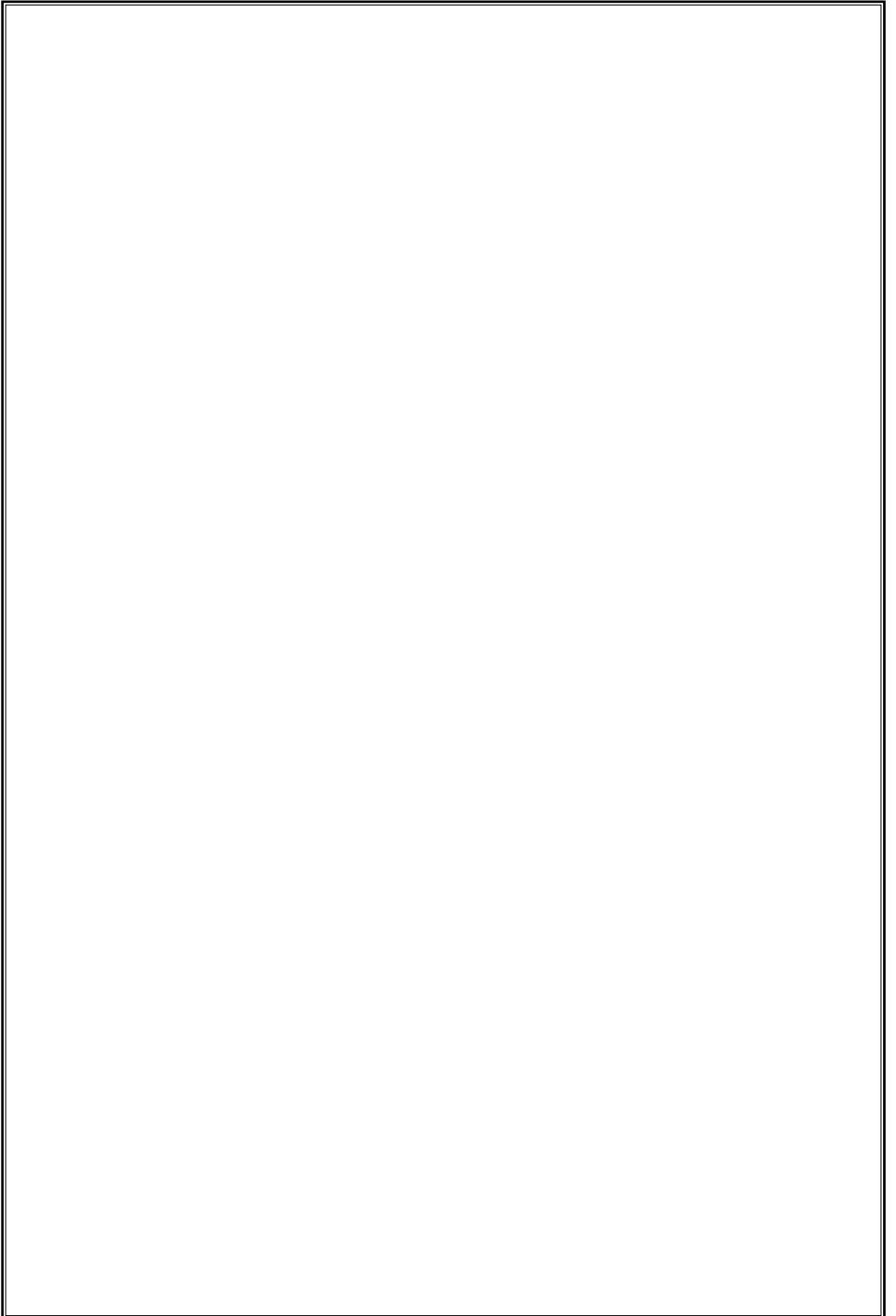
**ADICHUNCHANAGIRI
UNIVERSITY**

Faculty of Engineering, Management & Technology

**BE (ELECTRONICS AND COMMUNICATION
ENGINEERING)**

**CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME (2022-23)**

**B G Nagara, Nagamangala Taluk, Mandya District,
Karnataka-571448**



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION:

To develop high quality engineers with technical knowledge, skills and ethics in the area of Electronics and Communication Engineering to meet industrial and societal needs.

MISSION:

- M1. To provide high quality technical education with up-to-date infrastructure and trained human resources to deliver the curriculum effectively in order to impart technical knowledge and skills.
- M2. To train the students with entrepreneurship qualities, multidisciplinary knowledge and latest skill sets as required for industry, competitive examinations, higher studies and research activities.
- M3. To mould the students into professionally-ethical and socially-responsible engineers of high character, team spirit and leadership qualities.

Program Educational Objectives:

- PEO1. Have successful technical career in industry and pursue higher studies and research.
- PEO2. Utilize their knowledge and skills to propose solutions as Electronics and Communication Engineer to solve societal problems with ethical values.
- PEO3. Display multidisciplinary professional and leadership qualities and adapt to lifelong learning.

Program Specific Outcomes:

- 1. To apply the core knowledge of electronics and communication engineering as well as automation tools to analyse, design, create electronic circuits, systems and solutions.
- 2. To collaborate effectively with Electronics and Information Technology industries through internship, induction, technical seminar, technical project, research, product design and development, industrial visit, staff training in order to provide the actual industrial exposure to students and faculties.

Program outcomes (POs)-12 Graduate Attributes

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** 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.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.



ACU/AUTY/720/1/2022-23

Date: 25/11/2022

NOTIFICATION

Sub: Regulations of 2022 Scheme and CBCS Curriculum for BE & M.Tech Programs- reg.

- Ref: 1. Proceedings of the 12th meeting of CAC held on 09.09.2022
2. Minutes of the 9th meeting of the Board of Management held on 19.05.2022.
3. Notification No. ACU/AUTY/AC-09/101/1/2022-23, dated 10.05.2022.


With reference to the above, the Regulations of 2022 Scheme and Choice Based Credit System (CBCS) for UG and PG (All Programs) was notified (Ref.3). Further, in accordance with the resolutions of the Boards of Studies - Faculty of Engineering, Management & Technology BGS Institute of Technology Committee of Academic Council and Board of Management as referred above; it was decided to approve the Regulations 2022 scheme and Choice Based Credit System (CBCS) for UG and PG programs by the University.

These Regulations of 2022 scheme and CBCS Curriculum shall be effective for students admitted to BE & M.Tech course from the academic year 2022-23 onwards.

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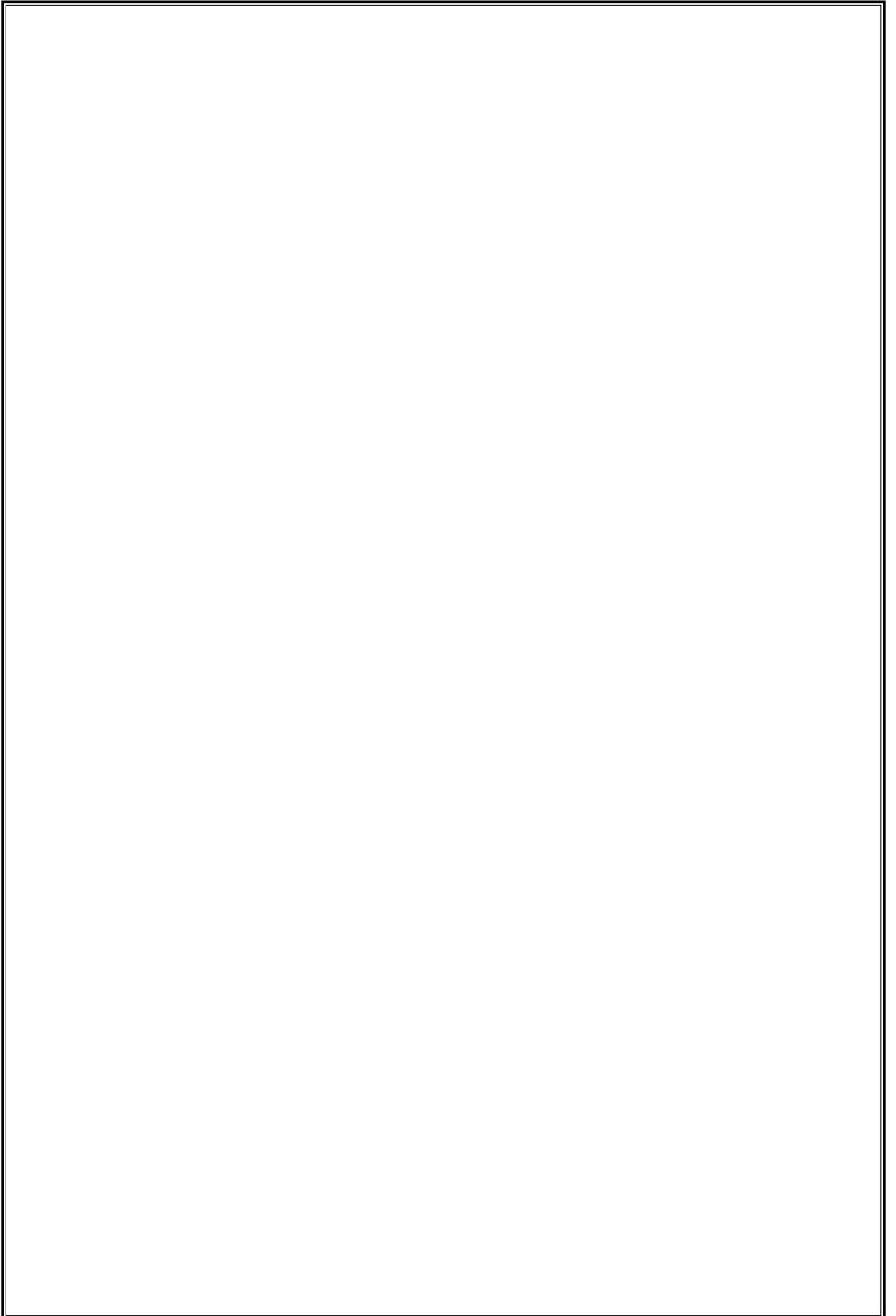
1. PS to the Hon'ble Visitor, His Excellency, the Governor of Karnataka
2. PS to the Hon'ble Chancellor
3. OSD to the Vice-Chancellor
4. Secretary, Ministry of Higher Education, Government of Karnataka
5. PS to the Registrar (Evaluation), ACU
6. Dean, Research, ACU
7. Dean, Academics and Accreditations, ACU
8. Principal, BGSIT, B.G.Nagara-571448, Nagamangala (Tq), Mandya (Dist)
9. Office Copy

By order,


Dr. C.K. Subbaraya
Registrar
Adichunchanagiri University
B.G.Nagara-571448

Adichunchanagiri University, BG Nagara
Regulations Governing the Degree of BE Under Choice Based Credit
System (CBCS) Scheme
Effective from academic year 2022-23

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Adichunchanagiri University, BG Nagara
REGULATIONS GOVERNING
THE DEGREE OF BACHELOR OF ENGINEERING (BE) UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)

Effective from the academic year 2022-23

Definitions of Keywords

The following are the definitions/descriptions that have been followed for the different terms used in the Regulations of BE Programme:

- 1) **Programme:** It is an educational programme in a particular stream/branch of Engineering/branch of specialization leading to award of Degree. It involves events/activities, comprising of lectures/ tutorials/ laboratory work/ field work, outreach activities/ project work/ vocational training/ viva/ seminars/ internship/ assignments/ presentations/ self-study etc., or a combination of some of these.
- 2) **Branch:** Means specialization or discipline of BE Degree Programme, such as Civil Engineering, Mechanical Engineering, Electronics & Communication Engineering, Computer Science & Engineering and Information Science & Engineering, Artificial Intelligence and Machine Learning.
- 3) **Register Number:** It is the unique identification number assigned to all the admitted students of the University.
- 4) **Semester:** Refers to one of the two sessions of an academic year (vide: serial number 5), each session being of sixteen weeks duration (with working days greater than or equal to ninety). The odd semester may be scheduled from August and even semester from February of the academic year.
- 5) **Academic Year:** Refers to the sessions of two consecutive semesters (odd followed by an even) including periods of vacation.
- 6) **Course:** Refers to usually referred to as 'papers' and is a component of a programme. All courses need not carry the same weightage (credit). The courses should define course objectives and course outcomes. A course may be designed to comprise lectures/ tutorials/ laboratory work/ field work/ outreach activities/project work/ vocational training/ viva/ seminars/ term papers/assignments/ presentations/ self-study, etc., or a combination of some of these.

- 7) **Credit:** Refers to a unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of lecture or two hours of laboratory/ practical courses/ tutorials/ fieldwork per week, etc.
- 8) **Audit Courses:** Means knowledge/ skill enhancing courses without the benefit of a grade (vide: serial number 18) or credit for a course.
- 9) **Choice Based Credit System (CBCS):** Refers to customizing the course work, through Core, Elective and Soft skill courses, to provide necessary support for the students to achieve their goals.
- 10) **Course Registration:** Refers to formal registration for the courses of a semester (Credits) by every student under the supervision of a Faculty Advisor (also called Mentor, Counselor etc.,) in each Semester for the Institution to maintain proper record.
- 11) **Course Evaluation:** Means Continuous Internal Evaluation (CIE) and Semester End Examinations (SEE) to constitute the major evaluations prescribed for each course. CIE and SEE to carry 50% and 50% respectively, to enable each course to be evaluated for 100 marks, irrespective of its Credits.
- 12) **Continuous Internal Evaluation (CIE):** Refers to evaluation of students' achievement in the learning process. CIE shall be by the Course Instructor and includes tests and any one of the following, homework, problem solving, group discussion, quiz, mini-project and seminar throughout the Semester, with weightage for the different components being fixed as per the BOS.
- 13) **Semester End Examination (SEE):** Refers to examination conducted at the University level covering the entire course syllabus. For this purpose, syllabi to be modularized and SEE questions to be set from each module, with a choice confined to the concerned module only. SEE is also termed as University examination.
- 14) **First Attempt:** Refers to a student who has completed all formalities and has become eligible to attend the SEE and has attended at least one head of passing, such attempt shall be considered as first attempt.
- 15) **Make up Examination:** It is the examination conducted to the failed / rejected courses after Even Semester as specified by the calendar of events of the University.

16) Credit Based System (CBS): Refers to quantification of course work, after a student completes teaching – learning process, followed by passing in both CIE and SEE. Under CBCS, the requirement for awarding degree is prescribed in terms of total number of credits to be earned by the students.

17)Credit Representation: Refers to Credit values for different academic activities considered, as per the Table-1. Credits for seminar, project phases, project viva–voce and internship shall be as specified in the Scheme of Teaching and Examination (Annexure -1).

Table-1: Credit Values

Theory/ Lectures (L) (hours/week/ Semester)	Tutorials (T) (hours/week/ Semester)	Laboratory/Practical (P) /practical train- ing(hours/week/Se mester)	Credits (L:T:P)	Total Credits
4	0	0	4:0:0	4
3	0	0	3:0:0	3
2	2	0	2:1:0	3
2	0	2	2:0:1	3
2	2	2	2:1:1	4
0	0	6	0:0:3	3

NOTE: Activities like study tour and participation in guest lectures not to carry Credits.

18) Letter Grade: It is an index of the performance of students in a said Course. Grades are denoted by letters S, A, B, C, D, E and F.

19) Grading: Grade refers to qualitative measure of achievement of a student in each course, based on the percentage of marks secured in (CIE plus SEE). Grading is done by Absolute Grading [Refer: 22BE6.0]. The rubrics attached to letter grades are as follows: S – Outstanding, A – Excellent, B – Very Good, C – Good, D – Above Average, E – Average and F – Fail.

20) Grade Point (GP): Refers to a numerical weightage allotted to each letter grade on a 10- point scale as under:

**Letter Grade and corresponding Grade Points on a typical
10 – Point scale**

Letter Grade	S	A	B	C	D	E	F
Grade Point	10	09	08	07	06	04	00

- 21) **Passing Standards:** Refers to passing a course only when getting GP greater than or equal to 04 (as per serial number 18).
- 22) **Credit Point:** It is the product of grade point (GP) and number of credits for a Course i.e.,
Credit Point (CrP) = GP × Credits for the Course
- 23) **Semester Grade Point Average (SGPA):** Refers to a measure of academic performance of student/s in a semester. It is the ratio of total credit points secured by a student in various Courses of a semester and the total course credits taken during that semester. [Refer:22BE6.0]
- 24) **Cumulative Grade Point Average (CGPA):** Refers to a measure of overall cumulative performance of a student overall semesters. The CGPA is the ratio of total credit points earned by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places. [Refer: 22BE6.0]
- 25) **Transcript or Grade Card or Certificate:** Refers to a certificate showing the grades earned by a student. A grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the programme details (Course code, title, number of credits, grades secured) along with SGPA of that semester and CGPA earned till that semester.
- 26) **University:** Adichunchanagiri University (ACU), BG Nagara.

Adichunchanagiri University, BG Nagara
Regulations Governing the Degree of Bachelor of Engineering (BE)
 Under Choice Based Credit System (CBCS)
 (With effective from the academic year 2022-23)

22BE 1.0	Title, Duration and Credits of the Programme of Study
22BE 1.1	The programme of study shall be called the Degree of Bachelor of Engineering abbreviated as BE (Subject of Specialization).
22BE 1.2	<p>The programme to which students are admitted to I Semester of the programme shall be of four academic years duration divided into eight semesters and each semester is of 16 weeks duration.</p> <p>The programme to which students are admitted to III Semester of the programme under lateral entry shall be of three academic year duration divided into six semesters and each semester is of 16 weeks duration.</p> <p>The programme (conducted during evening) to which students are admitted to III semester of the programme under lateral entry shall be of three academic year duration divided into six semesters and each semester is of 16 weeks duration. The deficit Contact hours of the programme, conducted during evening on all working days, shall be compensated on all Sundays (except on general holidays).</p>
22BE 1.3	The calendar of events in respect of the programme of study shall be notified by the University in advance.
22BE 1.4	The University examination in all programmes of study shall be conducted at the end of each semester for all the eight semesters.
22BE 1.5	<p>Maximum Duration for Programme Completion:</p> <p>a)</p> <p>i. Students admitted to I Year BE shall complete the programme within a period of Eight academic years from the date of first admission, failing which they have to discontinue the course.</p> <p>ii. Students admitted to II Year BE under lateral entry scheme shall complete the programme within a period of Six academic years from the date of first admission, failing which he/she has to discontinue the Course.</p> <p>b)</p> <p>i. A student who has not obtained the eligibility for III Semester even after three academic years from the date of admission to I Semester shall discontinue the programme or get readmitted to I Semester of I Year BE with a new University Seat Number.</p>

22BE 1.5	ii. A student (under lateral entry scheme) who has not obtained the eligibility for V Semester even after three academic years from the date of admission to III Semester shall discontinue the Programme or get readmitted to III Semester of II Year BE with a new University Seat Number.
22BE 1.6	<p>Prescribed number of Credits for the Programme:</p> <p>(a) The number of credits to be completed by students admitted to I year Semester of BE programme shall be 166.</p> <p>(b) The number of credits to be completed by students admitted to III Semester of BE Programme under lateral entry scheme shall be 126.</p>
22BE 1.7	<p>Definition of credits</p> <p>1 hour Lecture(L) per week per semester=1 credit</p> <p>2 hour Tutorial(T) per week per semester=1 credit</p> <p>2 hour Practical/Practical Training/Laboratory/Drawing (P) per week per semester=1 credit</p>
22BE 2.0	Eligibility for Admission (As per the Government orders issued from time to time)
22BE 2.1	<p>Admission to I Year/ I Semester Bachelor Degree in Engineering shall be open to the students who have passed the II PUC/ XII Standard/ Equivalent Examination with English as one of the Languages and obtained a Minimum of 45% of Marks in aggregate in Physics and Mathematics along with Chemistry / Bio-Technology / Biology / Electronics / Computer.</p> <p>In case of SC/ST, Category-1 and OBC (2A, 2B, 3A and 3B) category students from Karnataka (Karnataka candidates), the minimum marks for eligibility shall be 40%. With regard to the qualification earned from foreign countries, Equivalence Certificate from the Association of Indian Universities is Mandatory for admission to BE programme. In case of any dispute about the equivalence in qualification earned from foreign countries, the decision of the Equivalence Committee shall be the final in establishing the eligibility of the student.</p> <p>Admission to II Year/ III Semester Bachelor Degree in Engineering (Lateral Entry) shall be open to the Diploma holders and B.Sc. graduates.</p>

(i) Diploma Holders

(a) Must have passed diploma or equivalent examination as recognized by University and secured not less than forty five percentage (45%) marks in the final year examination (fifth and sixth semesters) in the appropriate branch of engineering. In case of SC/ST and OBC students from Karnataka, the minimum marks for eligibility shall be forty percent (40%).

(b) Those candidates who have completed Diploma from other than Karnataka State shall provide the Equivalence/ Eligibility Certificate from the Director of Technical Education, Karnataka.

(ii) B.Sc. Graduates

Must have passed B.Sc. degree from a recognized University under the UGC or equivalent qualification as recognized by University and secured not less than forty five percentage (45%) marks in aggregate (considering the marks of all six semesters). In case of SC/ST and OBC students from Karnataka (Karnataka candidates) the minimum marks for eligibility shall be forty percent (40%).

Candidates must have studied Mathematics as subject of study at XII Standard.

22BE 2.2

(i) Diploma Holders for the programme conducted during evening:

A candidate who has passed diploma examination or equivalent examination and obtained an aggregate minimum of 45% marks taken together in all the subjects of the final year (fifth and sixth semesters) diploma examination is eligible to BE Courses, and 40% of marks in case of SC/ST and backward classes of Karnataka candidates.

In addition to this, a candidate after passing the diploma, must have minimum of two years full-time professional experience as on first September of the year of admission, in a registered firm/company/ industry/ educational / Government / Autonomous organizations in the branch of Engineering/ Technology, in which the candidates hold a diploma, and in which admission is sought by him/her.

Further that employment shall be in an establishment situated within the 100 km from the place of the institution to which the candidate is seeking admission. Professional experience refers to the experience earned as an employee on regular basis in,

(a) Government, Government Undertaking, Public Sector Undertaking, Corporation or,

<p>22BE 2.2 (continued)</p>	<p>(b) In a private company registered under the Directorate of Industries and Commerce or the Directorate of Small Scale Industries or, (c) Government, Government recognized Institutions as technical staff. Provided that the period of apprenticeship undergone shall also be treated as professional experience, if sponsored by the Board of Apprenticeship Training, Southern Region, Chennai or by Government, Government undertakings and Public Sector undertakings. Further, those candidates who have completed Diploma from other than Karnataka state shall provide the Equivalence/ Eligibility Certificate from the Director of Technical Education, Karnataka.</p>
<p>22BE 2.3</p>	<p>Those students, who have passed a qualifying examination other than the PUC II examination of the Pre-University Education Board of Karnataka, have to obtain Eligibility Certificate for seeking admission to BE Degree Programme from Adichunchanagiri University, BG Nagara.</p>
<p>22BE 3.0</p>	<p>Courses</p>
<p>22BE 3.1</p>	<p>There shall be the following types of Courses:</p> <ul style="list-style-type: none"> a) Humanities and Social Sciences (HSS) including Management. These are mandatory for all disciplines. b) Basic Sciences (BS): Physics, Chemistry and Mathematics. These are mandatory for all disciplines. c) Engineering Sciences (ES): Materials, Drawing, and Basics of Electrical/ Electronics/ Instrumentation/ Civil/ Mechanical/ Computer Engineering. These are mandatory for all disciplines. d) Professional Subjects (PS) - Core: These are the Professional Core (PC) courses, relevant to the chosen specialization/ branch. The core Courses are to be compulsorily studied by a student and are mandatory to complete them to fulfil the requirements of a programme. e) Professional Subjects (PS) - Elective: These are the Professional Electives (PE), relevant to the chosen specialization/ branch and can be chosen from the pool of papers. It shall be supportive to the discipline providing extended scope/enabling an exposure to some other discipline /domain and nurturing student proficiency skills. f) Open Subjects - Electives (OE): These are from other technical areas and/ or from emerging fields. g) Mini Project and Main Project: Carried out at the Institution or at an Industry. h) Seminar: Deliverable at the Institution under the supervision of a Faculty.

22BE 3.1	<p>i) Internship: Preferably at an industry/R & D organization/IT company/ Government organization of significant repute for a specified period mentioned in the Scheme of Teaching and Examination.</p> <p>j) Mandatory Courses (MC): These courses are mandatory, without the benefit of a grade or credit, for students admitted to BE programme. A pass in each mandatory course is required to qualify for Degree award from the University.</p> <p>k) Audit Courses (AC): Knowledge/ skill enhancement courses without the benefit of a grade or credit for a course.</p> <p>i) The Audit Course/s (other than the Course/s considered for completing the prescribed programme credits) can be any Course offered by the programme to which the student is admitted to other programmes offered in the institution, where</p>
22BE 3.1 (continued)	<p>the student is studying.</p> <p>ii) The students who are interested in audit courses can register for one audit course at a time during III to VIII Semesters. Students, who have opted for audit courses and considered on par with students registered for credit courses, have to satisfy the attendance and CIE requirements. However, they need not have to appear for SEE.</p> <p>iii) Registration for any audit course, in writing, shall be completed at the beginning of semesters. The Institution should intimate the Registrar (Evaluation) about the registration at the beginning of the semester and obtain a formal approval for inclusion of the audit Course/s in the Grade cards/ Transcripts issued to the students.</p>
22BE 3.2	The minimum number of students registered to any Elective offered by the Departments shall be not less than fifteen.
22BE3.3	A student shall exercise his option in respect of Elective Courses and register for the same at the beginning of the concerned semester. The student may be permitted to opt for a change of Elective Course within 15 days from the date of commencement of the semester as per the calendar of the University.
22BE3.4	Course Registration: Every student shall register for the Courses of a semester (Credits) under the supervision of a Faculty Advisor (also called Mentor, Counsellor etc.) in each Semester for the Institution to maintain proper record.
22BE4.0	Internship/Professional Practice/Practical Examinations/Project work

22BE4.1	<p>1) The Department/college shall nominate staff member/s to facilitate, guide and supervise students under Internship/ Professional Practice/Practical Examinations/Project work.</p> <p>2) The Internship shall be completed during the period specified for four weeks during the vacation of VI and VII semesters and/or VII and VIII Semester</p> <p>3) The internship can be carried out in any industry/R & D Organization/Research Institute/Educational institute of repute.</p> <p>4) The students shall report the progress of the Internship/ Professional Practice/Practical Examinations/Project work to the guide at regular intervals and seek his/her advice.</p> <p>5) After the completion of Internship/Professional Practice/Practical Examinations/Project work, students shall submit a report with completion and attendance certificates to the Head of the Department with the approval of guides.</p> <p>6) There will be 50 marks for CIE (Seminar: 25 & Internship Report: 25) and 50 marks for Viva-voce conducted during SEE with two Internal Examiners. The minimum requirement of CIE marks shall be 50% of the maximum marks. [To be read along with 22BE8.6]</p> <p>7) The guide shall award the marks for Seminar /Viva-voce on Internship/Professional Practice/Practical Examinations/Project work Report after evaluation. He/she will also be the internal examiner for Viva-voce conducted during SEE.</p> <p>8) Viva-voce on Internship/Professional Practice/Practical Examinations/Project work shall be conducted at the college with two internal Examiners. The Examiners shall jointly award the Viva-voce marks.</p> <p>9) The students are permitted to carry out the internship anywhere in India or abroad. The University will not provide any kind of financial assistance to any student for carrying out the Internship.</p>
22BE4.2	<p>Failing to undergo Internship: Internship is one of the head of passing. Completion of internship is mandatory. If any student fails to undergo /complete the internship, he/she shall be considered as failed in that Course and shall not be permitted to appear for SEE in that Course. However, student shall appear for SEE after satisfying the conditions prescribed for Internship. The reappearance shall be considered as an attempt.</p>
22BE5.0	<p>Seminar and Project Work</p>

22BE 5.1	<p>Seminar: Seminar is one of the head of passing:</p> <p>i) Each candidate shall deliver Seminar as per the Scheme of Teaching and Examination on the topics chosen from the relevant fields with latest topics for about 20 minutes.</p> <p>ii) The Head of the Department shall make arrangements for conducting seminars through concerned faculty members of the Department. The committee constituted for the purpose by the Head of the Department shall award the CIE marks for the seminar. The committee shall consist of three faculties from the Department and the senior most acting as the Chairman/Chairperson. [To be read along with 22BE8.6].</p>																																							
22BE 5.2	<p>Project Work: Project (Mini and Main)Work is one of the head of passing:</p> <p>Mini Project work and Main Project work shall preferably be batch wise, the strength of each batch shall not exceed maximum of four students (minimum of 2).</p>																																							
22BE 5.3	<p>Viva-voce examination in Mini Project work and Main Project work shall be conducted Batch-wise.</p>																																							
22BE 6.0	Computation of SGPA and CGPA																																							
22BE 6.1	<p>i) The University adopts absolute grading system wherein the marks are converted to grades, and every semester results will be declared with semester grade point average (SGPA) and Cumulative Grade Point Average (CGPA). The CGPA will be calculated for every semester, except for the first semester.</p> <p>ii) The grading system with the letter grades and the assigned range of marks under absolute grading system are as given below:</p> <table border="1"> <thead> <tr> <th>Level</th> <th>Out-standing</th> <th>Excel-lent</th> <th>Very Good</th> <th>Good</th> <th>Above Aver-age</th> <th>Aver-age</th> <th>Fail</th> </tr> </thead> <tbody> <tr> <td>Letter Grade</td> <td>S</td> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>F</td> </tr> <tr> <td>Grade Points</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>4</td> <td>0</td> </tr> <tr> <td rowspan="2">Per-centage of Marks Scored in a Course</td> <td>≥ 90</td> <td>$<90 \geq 80$</td> <td>$<80 \geq 70$</td> <td>$<70 \geq 60$</td> <td>$<60 \geq 45$</td> <td>$<45 \geq 40$</td> <td><40</td> </tr> <tr> <td>(90-100)</td> <td>(80-89)</td> <td>(70-79)</td> <td>(60-69)</td> <td>(45-59)</td> <td>(40-44)</td> <td>(0-39)</td> </tr> </tbody> </table>	Level	Out-standing	Excel-lent	Very Good	Good	Above Aver-age	Aver-age	Fail	Letter Grade	S	A	B	C	D	E	F	Grade Points	10	9	8	7	6	4	0	Per-centage of Marks Scored in a Course	≥ 90	$<90 \geq 80$	$<80 \geq 70$	$<70 \geq 60$	$<60 \geq 45$	$<45 \geq 40$	<40	(90-100)	(80-89)	(70-79)	(60-69)	(45-59)	(40-44)	(0-39)
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	(90-100)	(80-89)	(70-79)	(60-69)	(45-59)	(40-44)	(0-39)																																	

22BE 6.1

iii) A student obtaining Grade 'F' in a course shall be considered failed and is required to reappear in subsequent SEE. Whatever the letter grade secured by the student during his / her reappearance shall be retained. The failed student shall take make up examinations as per the calendar of events issued by the university.

22BE 6.2

Computation of SGPA and CGPA (as per UGC Guidelines)

The following procedures shall be used to compute the SGPA and CGPA respectively:

i) The SGPA is the ratio of sum of the product of the number of credits with the grade points secured by a student in all the courses taken by him/her and the sum of the number of credits of all the courses undergone by a student, i.e.,

Where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th course.

ii) The CGPA is also calculated in the same manner taking into account all the Courses undergone by a student over all the semesters of a programme, i.e.,

$$CGPA = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

where S_i is the SGPA of the i th semester and C_i is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal places and reported in the transcripts.

Illustration for Computation of SGPA and CGPA Computation of SGPA

Level				
Course	Credit	Grade letter	Grade point	Credit Point = (Credit × Grade)
Course 1	4	B	08	4 × 08 = 32
Course 2	4	D	06	4 × 06 = 24
Course 3	4	C	07	4 × 07 = 28
Course 4	3	S	10	3 × 10 = 30
Course 5	3	E	04	3 × 04 = 12
Course 6	3	D	06	3 × 06 = 18
Course 7	2	A	09	2 × 09 = 18
Course 8	2	D	06	2 × 06 = 12
Total	25	--	--	174
Thus, SGPA= 174/25 = 6.96				

Illustration No.2

Course	Credit	Grade letter	Grade point	Credit Point = (Credit × Grade)
Course 1	4	B	08	4 × 08 = 32
Course 2	4	D	06	4 × 06 = 24
Course 3	4	C	07	4 × 07 = 28
Course 4	3	S	10	3 × 10 = 30
Course 5	3	F	00	3 × 00 = 00
Course 6	3	D	06	3 × 06 = 18
Course 7	2	A	09	2 × 09 = 18
Course 8	2	D	06	2 × 06 = 12
Total	25	--	--	162

Thus, SGPA= 162/25 = 6.48

If a Student secures letter grade C during reappearance then the SGPA is Calculated as shown below.

Illustration No. 2(a)

Course	Credit	Grade letter	Grade point	Credit Point = (Credit × Grade)
Course 5	3	C	07	3 × 07 = 21

Total Credit Points = Credit Points of first Attempt + Credit Points of subsequent attempt = 162 + 21 = 183

Total credits of the semester = 25

Thus, SGPA= 183/25=7.32

Illustration No.3

Course	Credit	Grade letter	Grade point	Credit Point = (Credit × Grade)
Course 1	4	B	08	4 × 08 = 32
Course 2	4	D	06	4 × 06 = 24
Course 3	4	C	07	4 × 07 = 28
Course 4	3	S	10	3 × 10 = 30
Course 5	3	A	09	3 × 09 = 27
Course 6	3	D	06	3 × 06 = 18
Course 7	2	A	09	2 × 09 = 18
Course 8	2	D	06	2 × 06 = 12
Total	25	--	--	189

Thus, SGPA= 189/25 = 7.56

$$CGPA(\text{for illustrations 2 \& 3}) = \frac{25 \times 7.32 + 25 \times 7.56}{50} = 7.44$$

Semester	I	II	III	IV	V	VI	VII	VIII
Credits of the semester	24	24	27	27	24	24	24	26
SGPA	7.00	8.50	9.20	6.86	8.18	7.73	8.68	9.40

Thus CGPA

$$= \frac{24 \times 7.00 + 24 \times 8.50 + 27 \times 9.20 + 27 \times 6.86 + 24 \times 8.18 + 24 \times 7.73 + 24 \times 8.68 + 26 \times 9.40}{200} = 8.2$$

	Grade Card: Based on the secured letter grades, grade points, SGPA and CGPA, a grade card for each semester and a consolidated grade card indicating the performance in all semesters shall be issued.
22BE 7.0	Conversions of Grades into Percentage and Declaration of Class
22BE 7.1	Conversion formula for the conversion of CGPA into Percentage is given below: Percentage of marks secured, $P = [\text{CGPA Earned} - 0.75] \times 10$ Illustration for a CGPA of 8.20: $P = [8.2 - 0.75] \times 10 = 74.5\%$
22BE 7.2	Class Declaration: After the conversion of final CGPA into percentage of marks (P), a graduating student is declared to have passed in (i) First Class with Distinction (FCD) if $P \geq 70\%$ (ii) First Class (FC) if $P \geq 60\%$ but $<70\%$ and (iii) Second Class (SC) if $P < 60\%$.
22BE 8.0	Continuous Internal Evaluation
22BE 8.1	For each theory and practical paper, the CIE marks shall be 50. For Technical Seminar, the CIE marks shall be 50. For Internship/ Professional Practice, the CIE marks shall be 50. For Project Phase –I and Project Seminar and Project phase –II, the CIE shall be 100 respectively.
22BE 8.2	In case of theory, the CIE marks in each theory course shall be the sum of marks prescribed for test and assignment. Marks prescribed for test shall be 40 and that for assignment is 10. The CIE marks for test in a theory course shall be based on three tests generally conducted at the end of fifth, tenth and fourteenth week of each semester. Each test shall be conducted for a maximum of 40 marks and the final marks shall be the average of two best tests among the three tests. The remaining 10 marks shall be awarded based on the evaluation of Assignments/ Unit tests/written quizzes that support to cover some of the course/programme outcomes. Final CIE marks awarded shall be the sum of these two out of maximum of 50 marks. For English – I, English – II, Constitution of India, Environmental Studies and other audit courses CIE is conducted for 50 marks. The candidates shall write the Internal Assessment Tests and Assignments/Unit- Tests/ written quizzes in Blue Books which shall be preserved by the Principal / Head of the Department for at least two years after the announcement of University results and shall be made available for verification.

22BE 8.3	In the case of a Practical, the CIE marks shall be based on the laboratory records(40 marks on continuous evaluation based on conduct of experiment, viva and report writing) and one practical test (10 Marks) to be conducted at the end of the semester.
22BE 8.4	(i) The CIE marks for I Year Computer Aided Engineering / Drawing: a) 40 marks for class work (sketching and Computer Aided Engineering Drawing). b) 10 marks for test conducted in the same pattern as that of SEE. (ii) The CIE marks for other Drawings/ Design Drawings offered by various branches shall be based on the evaluation of the sheets and one test in the ratio 40:10. (iii) The CIE marks awarded for field work (like surveying Practice) shall be based on the evaluation of the associated field work and one test in the ratio 40:10.
22BE 8.5	The CIE marks in the case of projects and seminars in the final year shall be based on the evaluation at the end of VIII Semester by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the project / seminar guide.
22BE 8.6	i) Minimum CIE marks for all theory courses shall be 40% of the maximum marks prescribed for continuous internal evaluation. ii) Minimum requirement of CIE marks for Practical / Mini-Project / Internship / Technical Seminar / Project work Phase 2 shall be 50% of the maximum marks. iii) Minimum requirement of CIE marks for Technical Seminar shall be 40% of the maximum marks. iv) Minimum CIE marks for Project work Phase 1 shall be 50% of the maximum marks v) Minimum CIE marks for Additional Mathematics shall be 40% of the maximum marks prescribed for Continuous Internal Evaluation.
22BE 8.7	i) Students failing to secure the minimum percentage of CIE marks of any course/s shall not be eligible for the SEE conducted by the university and they shall be considered as fail in that course/s. However they can appear for University Examinations conducted in other courses of the same semester and backlog course/s if any. ii) Students who satisfied the attendance requirement but not the CIE requirements are permitted to register afresh and appear for SEE after satisfying CIE requirements in same course/s (with or

	<p>without satisfying the attendance requirement) when offered during subsequent semester/s.</p> <p>iii) If any student fails to secure a minimum of 40% of the maximum CIE marks in seminar / fails to deliver the seminar, he/she shall be considered as failed in that course and shall not be eligible for the award of degree. However, the student shall become eligible for the award of degree after satisfying the requirements prescribed for seminar during the subsequent semester/s.</p>
22BE 8.8	CIE marks of those students, who come under 22BE8.7, shall be sent separately to the Registrar (Evaluation).
22BE 8.9	If a student remains absent for all the CIE tests conducted, the CIE Marks shall be marked as AB for the courses against the Register Number of the student in the marks sheet submitted to the University by the Principal of the College.
22BE 8.10	<p>Improvement of CIE marks shall not be allowed in:</p> <p>a. Theory Courses where the student has already secured the minimum required marks.</p> <p>b. Laboratory / Workshop / Seminar / Internship / Project where the student has already secured the minimum required marks.</p>
22BE 8.11	The final list, incorporating corrections (if any) of CIE marks awarded to the students in the Theory/Practical/Internship/Project work/ Seminar, shall be displayed on the notice board of the college before the closure of the semester and a certified copy of the same shall be sent by the Principal to the University Examination Section within the stipulated date. Every page of the CIE marks sheet shall bear the signatures of the concerned Teacher/Teachers, Head of the Department and Principal.
22BE 8.12	Any corrections or overwriting of CIE marks shall bear the signature(s) of concerned Teacher(s) and in such cases the Head of the Department shall indicate the number of corrections on every sheet and attest it with his/her signature.
22BE 8.13	CIE marks shall reach the University before the commencement of examination as per the notification issued from the office of the Registrar (Evaluation) from time to time. After the submission of CIE marks to the University, any request under any circumstances for change of CIE marks may be considered with a valid reason.
22BE 9.0	Eligibility for Passing and Award of Degree (To be read along with 22BE4.2, 5.1,5.2, 8.6 and8.7)

22BE 9.1	<p>a) For a pass in a theory Course/Drawing, the student shall secure minimum of 35% of the maximum marks prescribed in the University examination and in total 40% of the maximum marks (i.e., prescribed for SEE and CIE) including the CIE marks secured by the student.</p> <p>b) The minimum passing letter grade in a course is 'E'.</p> <p>c) For a pass in a Practical/Internship/Project (Mini & Main) /Viva-voce examination, a Student shall secure a minimum of 40% of the maximum marks prescribed for the University Examination. The minimum passing grade in a course is 'E'.</p>
22BE 9.2	<p>1) A student who obtain any grade from 'S' to 'E' shall be considered as passed.</p> <p>2) If a student secures 'F' grade in any of the head of passing (22BE 4.2, 22BE 5.1, 22BE 5.2 and 22BE 11.2), he/she has to reappear in that head in the Make-up Examination and further if 'F' is secured, then he/she has to reappear for the SEE.</p> <p>3) A student will be declared successful at the end of programme, when he/she has none of the courses remaining with 'F' grade and shall have CGPA of greater than or equal to 5.00.</p>
	<p>4) In case, the CGPA falls below 5.00 at the end of the programme, the student shall be permitted to appear again for SEE in full or part of the previous semester courses by rejecting the performance for required number of course/s (other than seminar, project and practical) and times, subject to the provision of 22BE 1.5, to make up CGPA equal to or greater than 5.0. The student should reject the SEE results of the previous attempt and obtain written permission from the Registrar (Evaluation) to reappear in the subsequent SEE.</p>
22BE 9.3	<p>The student who do not satisfy the provision 22BE 9.2 (1) and the student who remain absent for the University examinations shall be deemed to have failed in that course/s. He/she has to reappear for the University examination in the subsequent examinations. The CIE marks awarded to the student at first attempt in the concerned theory Course/s will be carried forward.</p> <p>Revised CIE marks are considered only in cases under the provisions of 22BE8.7.</p>
22BE 9.4	<p>Student who passes a course of a semester as per 22BE 9.1 and has earned CGPA equal to or greater than 5.00 shall not be allowed to appear for any individual Course/s again, unless they opt for rejection of results of entire semester as per 22BE 9.5.</p>

22BE 9.5	A student may, at his/her desire, reject the total performance of a semester (including CIE marks) or reject only the result of his/her performance in SEE of a semester. The rejection is permitted only once during the entire programme of study.
22BE 9.6	The student who desires to reject the results of a semester shall reject performance in all the courses of the semester, irrespective of whether the student has passed or failed in any course. However, the rejection of performance of VIII Semester project shall not be permitted.
22BE 9.7	A student, who desires to reject the total performance of a semester including CIE marks, has to take readmission for that semester. Application for approval of readmission shall be sent to the Registrar through the Principal of College within 30 days from the date of the announcement of the results. Readmission to first semester in such cases shall not be considered as fresh admission and therefore the student will continue to have the same Register Number, which was allotted earlier. The Course duration (as per 22BE 1.5) will be counted with reference to old Register Number.
22BE 9.8	The student, who rejects only the results of University examination of a semester, shall be permitted to reappear for University examinations of all the Courses of that semester in the subsequent examinations. However, the CIE marks obtained by the student in the rejected semester shall be retained. Applications for rejection and approval to reappear for University examination shall be sent to the Registrar (Evaluation) through the Principal of the College within 30 days from the date of announcement of the results. If the rejection of results of University examination is of odd semester, the student shall be allowed to take admission to the immediate next even semester. However, if the rejection of results of University examination is of even semester, then the student shall not be allowed to take admission to the next odd semester (as per 22BE 11.2).
22BE 9.9	Students who opt for rejection of results of University examinations are eligible for the award of class and distinction, but are not eligible for the award of ranks.
22BE 9.10	A student shall be declared to have completed the programme of BE degree, provided the student has undergone the stipulated Course work as per the Scheme of Teaching and Examination and has earned the prescribed number of credits as per the provision 22BE1.6, having CGPA ≥ 5 with none of the registered courses remaining with 'F' grade.

22BE 9.11	<p>Student who find it too difficult to pass a course can drop the course/s after CIE-1 the total number of credits registered even after dropping a course/s shall be at least 20.</p> <p>i) A specific period shall be fixed for dropping courses in a given Semester after the announcement of CIE-I result based on the recommendations of the Mentor in consultation with the course teacher. The same shall be recommended by the concerned Head of the Department. Dropping of courses/s shall not appear in the Grade Card.</p> <p>ii) If core course/s are dropped, such course/s are to be reregistered whenever the course/s are offered. However, if the dropped course/s are electives, then students have an option to reregister either for the same or an equivalent course/s later, depending on the availability of course/s with the consent of the Mentor and approval from the concerned Head of the Department.</p>
22BE 9.12	<p>i) A student shall be permitted to withdraw temporarily from the programme on grounds like, prolonged illness, calamity in the family or any other serious happening. The withdrawal shall be for periods which are integral multiples of a Semester provided:</p>
	<p>a) The student shall present the facts to the college within 6 weeks from the date; he/she has last attended the classes stating fully the reasons for such a withdrawal, together with supporting documents and endorsement of his/her parent or guardian. Further, the Principal has to forward to the University and get the approval.</p> <p>b) The student shall not have any dues to the College.</p> <p>ii) A student availing temporary withdrawal from the programme of study under above provision shall be required to pay such fees and/or charges as may be fixed by the University at the time of reporting to the College to continue the programme. The fees/charges once paid shall not be refunded.</p> <p>iii) A student shall be entitled to avail the temporary withdrawal facility only once during his/her studentship of the programme at the University. The withdrawal period shall be such that the candidate can complete the programme requirement (166 credits for students admitted in I Year and 126 credits for Lateral entry students) within the time limits specified by the University. However, any other permissible concession requested by the concerned student shall have to be at the discretion of the Registrar.</p>
22BE 10.0	Attendance Requirement

22BE 10.1	Courses of each semester shall be treated as a separate unit for calculation of the attendance. The candidate has to put in a minimum attendance of 75% in each course with a provision to condone 10% of the attendance by the Dean on the specific recommendations of the Head of the Department where the student is studying, based on medical grounds, participation in University/State/ National/ International level sports and cultural activities, seminars, workshops, paper presentation, etc., of significant value. The supporting documents for condoning the shortage of attendance are to be submitted along with the specific recommendations.
22BE 10.2	<p>a) The basis for calculation of attendance shall be the period prescribed by the university by its calendar events.</p> <p>b) For course/s having lecture and tutorial hours, attendance shall be with respect to 75% of attendance in lecture hour and 75% of attendance in tutorial hours. If the attendance requirement is not satisfied in any one of them, the candidate shall be considered as not satisfied the attendance condition. Condonation of 10% shall be applied separately to lecture and tutorial hour to make up the deficiency in attendance. Faculties shall also maintain the attendance of students of lecture and tutorial hours separately in the same register or in separate registers.</p> <p>c) In case of late admission, approved by competent authority (ACU), to I Semester/III semester / III semester (lateral entry scheme) of Engineering programme, the attendance shall be reckoned from the date of admission to the programme.</p>
22BE 10.3	The Course Instructor/ Mentor/College shall inform the students as well as their parents about the attendance status periodically. Students who are facing the shortage of Attendance be mentored to make up the shortage.
22BE 10.4	A candidate, who does not satisfy the attendance requirement (in one or more courses) as mentioned in 22BE10.1 shall not be eligible to appear for the SEE & Make up examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.
22BE 10.5	The detained list shall be sent to Registrar (Evaluation) one week prior to the commencement of the examination. The detained students should obtain permission from Principal, for readmission to the semester concerned as a repeater.

22BE 11.0	Vertical Progression (Promotion / Eligibility to higher Semesters)
22BE 11.1	There shall be no restriction for promotion from an odd semester to the next even Semester provided the student has fulfilled the attendance requirement.
22BE 11.2	<p>A student shall be declared failed if the candidate</p> <ul style="list-style-type: none"> i) Fail to satisfy the condition 22BE 9.1. ii) Absent himself / herself to the university examinations. iii) Is held guilty of examination malpractice and for any other reasons and declared the performance of any course/s null and void by a competent authority. iv) Has not satisfied the CIE requirements of any credit course/s v) Has not registered for the SEE even after satisfying the attendance and CIE requirements.
22BE 11.3	<p>A) Vertical Progression in case of students admitted to I Year.</p> <ul style="list-style-type: none"> a) A student with CGPA ≥ 5 at the end of first academic year and having no 'F' grade or having any number of 'F' grades in the two semesters of I Year of the program shall be eligible to move to II Year. i) A student with CGPA ≥ 5 at the end of second academic year and having any number of 'F' grades in the four semesters of I & II Year of the program shall be eligible to move to III Year. ii) A student with CGPA ≥ 5 at the end of third academic year and has earned all the prescribed credits of I Year and having any number of 'F' grades in the four semesters of II & III Year of the program shall be eligible to move to IV Year. <p>b) A student shall also be eligible for the first time, with a warning to move higher odd semester if he/she has failed to secure a minimum CGPA = 5 at the end of any academic year.</p> <p>c) For the award of degree a CGPA ≥ 5 at the end of program shall be mandatory.</p> <p>B) Vertical progression in case of students admitted to II Year (Lateral entry)</p> <ul style="list-style-type: none"> a) A student with CGPA ≥ 5 at the end of second academic year and having no 'F' grade or having any number of 'F' in the two semesters of II Year of the program shall be eligible to move to III Year. i) A student with CGPA ≥ 5 at the end of third academic year and having no 'F' grade or having any number of 'F' grades in the four semesters of II & III Year of the program shall be eligible to move to IV Year.

<p>22BE 11.3</p>	<p>b) A student shall also be eligible for the first time, with a warning to move higher odd semester if he/she has failed to secure a minimum CGPA = 5 at the end of any academic year. The mandatory non-credit courses Additional Mathematics prescribed at II Year, to lateral entry diploma holders admitted to third Semester of BE programs, shall compulsorily be registered during the respective Semesters to complete all the formalities of the course and appear for the CIE. For the award of degree a CGPA ≥ 5 at the end of program shall be mandatory. C) Vertical Progression in case B.Sc. students admitted to II Year (Lateral Entry)</p>
<p>22BE 11.3 (continued)</p>	<p>a) A student with CGPA ≥ 5 at the end of second academic year and having no 'F' grade or having any number of 'F' grades in the two semesters of II Year of the program shall be eligible to move to III Year. i) A student with CGPA ≥ 5 at the end of third academic year and having no 'F' grade or having any number of 'F' grades in the four semesters of II & III Year of the program shall be eligible to move to IV Year. b) A student shall also be eligible for the first time, with a warning to move higher odd semester if he/she has failed to secure a minimum CGPA = 5 at the end of any academic year. Lateral entrant students from B.Sc. stream shall clear the non-credit courses Computer Aided Engineering Drawing and Elements of Civil Engineering & Mechanics of the I Year Engineering Program. These courses shall not be considered for vertical progression from II Year to III Year. These courses shall be completed before eighth Semester. c) For the award of degree a CGPA ≥ 5 at the end of program shall be mandatory.</p>
<p>22BE 11.4</p>	<p>1) Noncompliance of CGPA ≥ 5 at the end of an academic year. i) In case the CGPA falls below 5 at the end of an academic year for the second time during the subsequent academic year the student shall not be permitted for the next higher odd Semester. ii) In case of 22BE 11.4 (1) (i), the students are permitted to appear again for SEE in full or part of the corresponding previous course/s by rejecting the performance of them (other than internship, technical seminar, project (mini & main) and laboratories) for any number of times subject to the provision of 22BE 1.5 to make up the CGPA equal to or greater than 5 for enrolment to next higher odd semester or for the award of degree.</p>

	<p>iii) The student should reject the SEE result of the previous attempt and obtain written permission from the Registrar (Evaluation) to reappear in the subsequent SEE.</p> <p>2) Noncompliance of Mini Project:</p> <p>a) The mini project shall be considered as a head of passing and shall be considered for the award of degree, those who do not take up/complete the mini project shall be declared as failed and shall have to complete the same during subsequent university examination after satisfying the mini project requirement, also mini project shall be considered for eligibility to VII Semester.</p> <p>3. Noncompliance of Internship:</p> <p>a) All the students admitted to III year of BE shall have to undergo mandatory internship of four weeks during the vacation of VI and VII semesters and/or VII and VIII Semester. A university examination shall be conducted during VIII Semester and the prescribed credits shall be included with the credits of VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those who do not take up / complete the internship shall be declared as fail and shall have to complete the same during subsequent University Examination after satisfying the internship requirement.</p>
22BE 12.0	Award of Prizes, Medals and Ranks
22BE 12.1	For the award of Prizes and Medals, the conditions stipulated by the donor shall be considered subject to the provisions of the statutes framed by the University for such awards.
22BE 12.2	<p>1) For award of rank in a specialization of Bachelor of Engineering, the CGPA secured by the students from III to VIII Semesters is considered.</p> <p>2) A student shall be eligible for a rank at the time of award of degree of Bachelor of Engineering, provided the student,</p> <p>a)(i) Has passed I to VIII Semester in all the credit courses in first attempt only in case of candidates admitted I Year.</p> <p>(ii) Has passed III to VIII Semester in all the credit courses in first attempt only in case of candidates admitted under lateral entry scheme.</p> <p>(iii) Has completed all the prescribed Audit/Mandatory Courses.</p> <p>b) Is not a repeater in any semester because of rejection of result of a semester/ shortage of attendance etc.</p> <p>c) Has completed all the semesters without any break/discontinuity.</p> <p>d) Has completed all the semesters (I to VIII/III to VIII) in ACU constituent college only.</p>

22BE 12.2	<p>e) Has not been transferred from any other University.</p> <p>3) The total number of ranks awarded shall be in the ratio of 10% of the total candidates for each course and up to a maximum of 10 ranks only in a discipline.</p>
22BE 12.3	<p>Ranks are awarded based on the merit of the students as determined CGPA. If two or more students get the same CGPA, the tie shall be resolved by considering the number of times a student has obtained higher SGPA. If it is not resolved even at this stage, the number of times a student has obtained higher grades like S, A, B etc., shall be taken into account to decide the order of the rank.</p>
22BE 13.0	Transfers of Students
22BE 13.1	<p>Transfer of students from one college to another college affiliated to other universities, within Karnataka State shall be permitted only at the beginning of third, fifth, and seventh semesters, subject to availability of seats within the permitted intake in the College and subject to the prior approval of the University. Further, the students must have passed in all the Courses of I and II Semesters for admission to III semester and all the Courses of I to IV Semesters for admission to V Semester and all the Courses of I to VI Semesters for admission to VII semester.</p> <p>The students seeking admission shall have to,</p> <p>i) Apply for establishment of equivalence with prescribed fees as notified by the ACU and obtain No Objection Certificate (NOC) for admission from the University before commencement of term as notified by ACU.</p> <p>ii) Produce NOC for admission from both the colleges before commencement of term as notified by ACU.</p> <p>iii) Complete additional Course/s, if any, as per the decision of concerned Board of Studies and approval of Dean, Faculty of Engineering, Technology & Management, on establishing equivalence between two schemes. A Grade card shall be issued to that effect. Additional Course/s shall not be considered for the eligibility criterion prescribed for promotion, class, calculation of SGPA and CGPA. However, a pass in the additional Courses, if any, is mandatory before the completion of Degree.</p>

<p>22BE 13.2</p>	<p>Transfer of students within the college from one branch to another branch at the start of III Semester shall be permitted with the approval of the Registrar, ACU subject to the Provisions made by the Government of Karnataka and AICTE on this behalf. Guidelines for change of branch are:</p> <p>i) Branch change at the college level shall be carried out by the Principal of the college.</p> <p>ii) Facility of branch change at the II Year (III Semester) level shall be available only to meritorious students and shall not to be considered as a matter of right.</p> <p>iii) Branch change is permitted at II Year (III Semester) only.</p> <p>iv) For the purpose of branch change, the “prescribed intake” shall be the intake prescribed by AICTE for the previous academic session when the students were admitted at I Semester level. Subsequent variations in intake shall have no bearings on the students eligible for branch change.</p> <p>v) Branch change is permitted, if strength in any Branch is not falling below 40% of the prescribed intake.</p> <p>vi) Branch change can be made against clear vacancy in a particular branch vacancy (V) being defined as:</p> $V = I - (\text{Reg.} + \text{Rep.})$ <p>Where I = The prescribed Intake for the branch.</p> <p>Reg. = No. of regular students who become eligible to be promoted to III Semester.</p> <p>Rep. = No. of students from previous batches who become eligible to join III Semester (along with regular students).</p> <p>vii) Branch change shall be strictly according to the Merit list prepared by the college on the basis of total marks obtained by a student in I Year University Examinations.</p> <p>viii) Change of branch should be completed within 30 days of announcement of I & II Semester (I Year) results.</p> <p>ix) Consolidated list showing the branch change as per above guidelines be sent to the University.</p>
<p>22BE 13.3</p>	<p>The University may prescribe fee for administrative purpose, which shall be notified from time to time, for transfer from one discipline to another discipline (change of branch within the College).</p>
<p>22BE 14.0</p>	<p>Applicability and Power to Modify</p>
<p>22BE 14.1</p>	<p>The regulations governing the Degree of Bachelor of Engineering of Adichunchanagiri University shall be a binding on all concerned.</p>

22BE 14.2	<p>i) Notwithstanding anything contained in the foregoing, the University shall have the power to issue directions/ orders to address any difficulty.</p> <p>ii) Nothing in the foregoing may be construed as limiting the power of the University to amend, modify or repeal any or all of the above.</p>
22BE 15	Convocation Ceremony
22BE 15.1	<p>There shall be an annual Convocation Ceremony in the University for the award of the Degree subject to if he/she has:</p> <p>i) Fulfilled Degree requirements in terms of earned credits (166 or 126 in case of lateral entry).</p> <p>ii) Satisfactorily completed mandatory courses.</p> <p>iii) Normal practice and disciplinary action pending against the student.</p>

BGS Institute of Technology
Scheme for First Semester B.E (Physics Cycle)

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination			Credits	
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	22MAT11	Engineering Mathematics – I	Mathematics	3	2	0	5	3	50	50	100	4	
2	22PHY12	Applied Physics	BS	3	1	0	4	3	50	50	100	3	
3	22CIV13	Civil Engineering & Mechanics	CV	2	2	0	4	3	50	50	100	3	
4	22ELE14	Basics of Electrical Engineering	ECE	3	0	0	3	3	50	50	100	3	
5	22CED15	Computer Aided Engineering Drawing	ME	2	0	2	4	3	50	50	100	3	
6	22PHYL16	Applied Physics Lab	BS	0	0	2	2	3	50	50	100	1	
7	22ELE17	Basic Electrical Engineering Lab	ECE	0	0	2	2	3	50	50	100	1	
8	22AEC18	Communicative English-I	HRD	3	2	0	5	3	50	50	100	1	
9	22 BIO19	Biology for Engineers	Humanities	0	--	2	2	2	50	50	100	1	
									450	450	900		
TOTAL CREDITS & CONTACT HOURS							31						20
TOTAL CREDITS OF I SEMESTER							31						20

Scheme for First Semester B.E (Chemistry Cycle)

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination				Credits
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	22MAT11	Engineering Mathematics – I	Mathematics	3	2	0	5	3	50	50	100	4	
2	22CHE12	Applied Chemistry	BS	3	1	0	4	3	50	50	100	3	
3	22 PCL13	Programming in C Language	CSE	3	1	0	4	3	50	50	100	3	
4	22ELN14	Basic Electronics	ECE	3	0	0	3	3	50	50	100	3	
5	22 EME15	Elements of Mechanical Engineering	ME	2	2	0	4	3	50	50	100	3	
6	22CHEL16	Applied Chemistry Lab	BS	0	0	2	2	3	50	50	100	1	
7	22CPL17	Computer Programming Laboratory	CSE	0	1	2	3	3	50	50	100	1	
8	22AEC18	Communicative English-I	HRD	3	2	0	5	1	50	50	100	1	
9	22 DS19	Data Science	CSE	0	--	2	2	1	50	50	100	1	
TOTAL CREDITS & CONTACT HOURS							31						20
TOTAL CREDITS OF I SEMESTER													20

SEE for Data Science and Biology for Engineers is conducted with one internal from Parent Department and one from other Department.

Scheme for Second Semester B.E (Physics Cycle)

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week				Examination				Credits	
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	22MAT21	Engineering Mathematics – II	Mathematics	3	2	0	5	3	50	50	100	4	
2	22PHY22	Applied Physics	BS	3	1	0	4	3	50	50	100	3	
3	22CIV23	Civil Engineering & Mechanics	CV	2	2	0	4	3	50	50	100	3	
4	22ELE24	Basics of Electrical Engineering	ECE	3	0	0	3	3	50	50	100	3	
5	22CED25	Computer Aided Engineering Drawing	ME	2	0	2	4	3	50	50	100	3	
6	22PHYL26	Applied Physics Lab	BS	0	0	2	2	3	50	50	100	1	
7	22ELE27	Basic Electrical Engineering Lab	ECE	0	0	2	2	3	50	50	100	1	
8	22AEC28	Communicative English-II	HRD	3	2	0	5	3	50	50	100	1	
9	22 BIO29	Biology for Engineers	Humanities	0	--	2	2	2	50	50	100	1	
									450	450	900		
TOTAL CREDITS & CONTACT HOURS							31						20
TOTAL CREDITS OF I SEMESTER												20	

Scheme for Second Semester B.E (Chemistry Cycle)

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week				Examination				Credits	
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	22MAT21	Engineering Mathematics – II	Mathematics	3	2	0	5	3	50	50	100	4	
2	22CHE22	Applied Chemistry	BS	3	1	0	4	3	50	50	100	3	
3	22 PCL23	Programming in C Language	CSE	3	1	0	4	3	50	50	100	3	
4	22ELN24	Basic Electronics	ECE	3	0	0	3	3	50	50	100	3	
5	22 EME25	Elements of Mechanical Engineering	ME	2	2	0	4	3	50	50	100	3	
6	22CHEL26	Applied Chemistry Lab	BS	0	0	2	2	3	50	50	100	1	
7	22CPL27	Computer Programming Laboratory	CSE	0	1	2	3	3	50	50	100	1	
8	22AEC28	Communicative English-II	HRD	3	2	0	5	1	50	50	100	1	
9	22 DS29	Data Science	CSE	0	--	2	2	1	50	50	100	1	
TOTAL CREDITS & CONTACT HOURS								31					20
TOTAL CREDITS OF I SEMESTER												20	

SEE for Data science and Biology for Engineers is conducted with one internal from Parent Department and one from other Department.

Semester	I	Course Title	Engineering Mathematics-I	Course Code	22MAT-11
Teaching Period	50 Hours	L – T – P – TL*	3 – 2 – 0 - 5	SEE	3 Hours
CIE	50 Marks	SEE*	50Marks	Total	100 Marks
Credit 4					

Course Learning Objectives:

This course (22MAT-11) will enable students to expert the basic tools of differential & integral calculus, differential equations and elementary linear algebra and become skilled for solving problems in science and engineering.

: MODULE-1: (10 Hours)

Differential Calculus-1: Review of elementary calculus, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation. Curvature and radius of curvature- Cartesian and polar forms (without proof).

: MODULE-2: (10Hours)

Differential Calculus-2: Taylor's and Maclaurin's series expansions for one variable (statements only), indeterminate forms- L-Hospital's rule. Partial differentiation; Total derivatives-differentiation of composite functions. Jacobians-Simple problems.

: MODULE-3: (10Hours)

Integral Calculus: Review of elementary integral calculus. Multiple integrals: Evaluation of double and triple integrals. Evaluation of double integrals- change of order of integration. Beta and Gamma functions: definitions, Relation between beta and gamma functions and simple problems.

: MODULE-4: (10Hours)

Ordinary differential equations (ODE's)of first order: Exact and reducible to exact differential equations. Bernoulli's equation. Applications of ODE's-orthogonal trajectories, Newton's law of cooling and L-R circuits. Nonlinear differential equations: Introduction to general and singular solutions; Solvable for p only; Clairaut's and reducible to Clairaut's equation only.

: MODULE-5: (10Hours)

Elementary Linear Algebra: Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method, Gauss –Jordan method and Gauss-Seidel method. Eigen values and eigen vectors- Rayleigh’s power method. Diagonalization of a square matrix of order two.

COURSE OUTCOMES:

On completion of this course, students will be able to understand:

- CO1:** Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve.
- CO2:** Learn the notion of partial differentiation to calculate rate of change of multivariate functions and solve problems related to composite functions and Jacobian.
- CO3:** Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
- CO4:** Solve first-order linear/nonlinear ordinary differential equations analytically using standard methods.
- CO5:** Make use of matrix theory for solving system of linear equations and compute eigen values and eigen vectors required for matrix diagonalization process.

RECOMMENDED LEARNING RESOURCES

Textbooks:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
- E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference books:

- C.Ray Wylie, Louis C.Barrett : “Advanced Engineering Mathematics”, 6th Edition, McGraw-Hill Book Co., New York, 1995.
- N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.
- B.V.Ramana: “Higher Engineering Mathematics” 11th Edition, Tata McGraw-Hill, 2010.

- Veerarajan T.,” Engineering Mathematics for First year”, Tata McGraw-Hill, 2008.
- Thomas G.B. and Finney R.L.” Calculus and Analytical Geometry”9th Edition, Pearson, 2012.

QUESTION PAPER PATTERN:

- The question paper will have ten full questions carrying equal marks.
- Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

WEBLINKS:

- <http://.ac.in/courses.php?disciplineID=111>
- [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
- <http://academicearth.org/>

Semester	I / II	Course Title	Applied Physics	Course Code	22PHY-12/22
Teaching Period	50 Hours	L – T – P – TL	3 – 1 – 0 – 4	SEE	3 Hours
CIE	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 03					

COURSE OBJECTIVES:

1. To recognize the importance and learn basic concepts of physics for engineering applications.
2. To identify the importance of quantum mechanics, lasers, optical fibers for advances in technology.
3. To understand the theoretical models used for the study of physical properties of various materials.

COURSE CONTENTS:

Quantum Mechanics:

::MODULE – 1:: (10 Hours)

Quantum theory of radiation: Black body radiation, Planck's law of radiation (Qualitative). Wave-Particle duality, De-Broglie Wavelength Hypothesis, De-Broglie wavelength for electron. Heisenberg's uncertainty principle and its illustration. Application: Non-existence of electrons in the nucleus.

Quantum Free electron theory of metals:

Quantum free electron theory – Assumptions, Fermi level, Fermi energy, Fermi velocity and Fermi factor. Variation of Fermi factor with Energy and temperature, Mention of Expression for density of states. Derive the expression for Fermi energy at absolute zero kelvin. Numerical Problems.

::MODULE – 2:: (10 Hours)

Oscillations and Waves:

Oscillations: Definition of SHM, Derivation of differential equation for SHM, Mechanical simple harmonic oscillators (mass suspended to spring oscillator), Equation of motion for free oscillations, Natural frequency of oscillations. Theory of damped oscillations: over damping, critical & under damping, quality factor. Theory of forced oscillations and resonance, Sharpness of resonance. One example for mechanical resonance.

Shock waves: Types of waves, Mach number, Properties of Shock waves, control volume. Construction and working of Reddy shock tube, applications of shock waves. Numerical problems.

::MODULE – 3:: (10 Hours)

Properties of Engineering Materials:

Elasticity: Basics of elasticity, Hooke's law, Types of elastic moduli, Poisson's ratio. Expression for Young's modulus (Y), Bulk modulus (K) and Rigidity modulus (η) in terms of α and β . Relation between Y, η and K.

Bending of Beams: Neutral surface and Neutral plane, Derivation of expression for bending moment of a beam with circular and rectangular cross section. Single cantilever derivation of expression for Young's modulus.

Torsion of cylinder: Expression for couple per unit twist of a solid cylinder, Torsional pendulum- Expression for period of oscillation.

::MODULE – 4:: (10 Hours)

Lasers and Optical fibers:

Lasers: Interaction of radiation with matter – Induced Absorption – Spontaneous Emission and Stimulated Emission. Expression for energy density of radiation in terms of Einstein's coefficients at thermal equilibrium. Requisites of a Laser system. Conditions for laser action. Principle, Construction and working of CO₂. Applications of Lasers in defense & medical field.

Optical fibers: Propagation mechanism, Angle of acceptance and Numerical aperture – their relationship with refractive indices of core and clad. Condition for propagation. Modes of propagation and Types of optical fibers. Attenuation: Causes of attenuation and mention of expression for attenuation coefficient, Discussion of block diagram of point-to-point communication system. Applications of optical fibers in communication and data storage. Numerical problems.

::MODULE – 5:: (10 Hours)

Physics of Materials:

Semiconductors: Classification of Semiconductors, Fermi level in intrinsic and extrinsic semiconductors. Expression for electron concentration in conduction band and mention the expression for hole concentration in

valance band of an intrinsic semiconductor. Expression for conductivity and resistivity of an intrinsic semiconductor in terms of mobility of charge carriers.

Dielectric Materials: Electric dipole, dipole moment, Dielectric constant, polarization of dielectric materials and types of polarization. Internal field in solids. Expression for Clausius-Mossotti equation. Numerical problems.

After completion of this course, students will be able to

- Distinguish between phase and group velocities and Apply the quantum theory to understand the electrical conductivity of metals
- Discuss the various types of oscillations and their implications, the role of Shock waves in various fields.
- Recognize the elastic properties of materials for engineering applications.
- Analyze suitability of lasers and optical fibers for engineering applications.
- Compute the carrier concentration in metals and semiconductors.

RECOMMENDED LEARNING RESOURCES:

Textbooks:

1. MN Avadhanulu and PG Kshirsagar, “A Textbook of Engineering Physics”, 10th revised Ed, S. Chand and Company Ltd, New Delhi.
2. Arthur Beiser, “Concepts of Modern Physics”, 6th Ed., Tata McGraw Hill Edu Pvt Ltd, New Delhi, 2006.
3. BB Laud, “Lasers and Non-Linear Optics”, 3rd Ed., New Age International Publishers, 2011.
4. Gaur and Gupta, “Engineering Physics”, Dhanpat Rai Publications, 2017.

Reference Books:

1. M. K. Verma, “Introduction to Mechanics”, 2nd Ed., University Press (India) Pvt. Ltd., Hyderabad, 2009.
2. O. Svelto, “Principles of Lasers”, Springer Science & Business Media, 2010.
3. B. G. Streetman, “Solid State Electronic Devices”, Prentice Hall of India, 1995.
4. MK Harbola, “Engineering Mechanics”, 2nd Ed., Cengage publications, New Delhi, 2009.

5. Chintoo S. Kumar, K. Takayama and K. P. J. Reddy, “Shock Waves made simple”, Wiley India Pvt. Ltd., New Delhi, 2014.
6. David Griffiths, “Introduction to Electrodynamics”, 4th Ed., Cambridge University Press, 2017,

QUESTION PAPER PATTERN:

- The question paper will have ten full questions carrying equal marks.
- Each full question consisting of 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Semester	I / II	Course Title	Civil Engineering and Mechanics	Course Code	22CIV13/23
Teaching Period	50 Hours	L – T – P – TL	2 – 2 – 0 – 4	SEE	3 Hours
CIE	50 Marks	SEE	50 Marks	Total	100 Marks
CREDITS – 03					

COURSE OBJECTIVES:

- To make students to learn scope of various fields of Civil Engineering, basics of civil engineering concepts and importance of infrastructural development.
- To develop a student’s ability to analyze the problems involving Forces and Moments with their applications,
- To develop a student’s ability to find the Centroid and Moment of inertia and their application

COURSE CONTENTS:

Introduction to Civil Engineering:

::MODULE – 1:: (08Hours)

Scope of different fields of Civil Engineering - Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering. Role of Civil Engineers in infrastructural development, Effect of the infrastructural facilities on socio-economic development of a country. Classification of Roads, Dams and Bridges.

::MODULE – 2:: (10 Hours)

Introduction to Engineering Mechanics:

Basic concepts of idealization, particle, continuum and rigid body; force; system of forces; Basic principles - physical independence of forces, Superposition, Transmissibility, Newton’s law of motion, Resolution and Composition of forces, Law of parallelogram of forces, Polygonal law, Resultant of Concurrent coplanar force system, moment and couple of forces.

::MODULE – 3:: (08 Hours)

Analysis of non Concurrent force system

coplanar non concurrent force system, moment of forces, couple, Varignon's theorem, Resultant of Coplanar non concurrent force system.

Analysis of Trusses: types of trusses, analysis of truss by method of joints.

::MODULE – 4:: (08 Hours)

Equilibrium of Forces:

Free body diagrams, Lami's theorem, Equations of Equilibrium, Equilibrium of concurrent and non concurrent coplanar force systems.

Support Reactions:

Types of Loads and Supports, statically determinate and indeterminate beams, Support reaction in beams. Numerical problems on support reactions for statically determinate beams (Point load, uniformly distributed and uniformly varying loads and Moments).

::MODULE – 5:: (08 Hours)

Centroid & Moment of Inertia:

Centroid of simple figures from first principle, centroid of composite/built-up sections; moment of inertia: Introduction, second moment of area of plane sections from first principles, Parallel and perpendicular axes theorems, Radius of gyration, Moment of inertia of composite area and built up sections.

Concept of product of inertia (No Problems).

COURSE OUTCOMES:

After a successful completion of the course, the student will be able to:

1. Mention the applications of various fields of civil engineering.
2. Compute the resultant of given force system subjected to various loads;
3. Compute the reactions developed in trusses
4. Comprehend the action of forces, moments and other loads on system of rigid bodies and compute the reactive forces that develop as a result of the external loads.
5. Locate the centroid and compute the moment of inertia of regular and built up sections.

RECOMMENDED LEARNING RESOURCES:

Text Books:

1. R.C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
2. Bansal R.K., A Text Book of Engineering Mechanics, Laxmi Publications.
3. Andy Ruina and Rudra Pratap, Introducing to Statics and Dynamics, Oxford University Press.
4. Reddy Vijaykumar K and K Suresh Kumar, Engineering Mechanics.
5. F.P. Beer and E. R. Johnston, Mechanics for Engineers, Statics and Dynamics, McGraw Hill.
6. Irving H. Shames, Engineering Mechanics, Prentice-Hall

Reference Books:

1. F.P. Beer and E.R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II,– Dynamics, Tata McGraw Hill
2. Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, Oxford University Press.
3. Reddy Vijay Kumar K. and K. Suresh Kumar, Singer's Engineering Mechanics.
4. Irving H. Shames, Engineering Mechanics, Prentice Hall.

QUESTION PAPER PATTERN:

- The question paper will have ten full questions carrying equal marks.
- Each full question consisting of 20 marks.
- There will be two questions (with a maximum of three sub questions) from each module.
- Students will have to answer five full questions, selecting one full question from each module

Semester	I / II	Course Title	Basic Electrical Engineering	Course Code	22ELE14/24
Teaching Period	42 Hours	L – T – P – TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

COURSE OBJECTIVES: This course will enable students

- To explain Ohm's law and Kirchhoff's laws used for the analysis of DC circuits.
- To explain fundamentals of AC circuits and the behaviour of R, L and C and their combinations in AC circuits.
- To discuss three phase balanced circuits.
- To explain principle of operation, construction and performance of electrical machines such as single phase transformer, DC machines, synchronous generator and three phase induction motor.
- To introduce concepts of electrical wiring, circuit protecting devices and earthing.

MODULE – 1

D.C. Circuits: Ohm's Law and Kirchhoff's Laws, analysis of series, parallel and series- parallel circuits excited by independent voltage sources, Power and Energy.

A.C. Fundamentals: Generation of sinusoidal voltage, frequency of generated voltage, definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities.

MODULE – 2

Single Phase Circuits: Analysis with phasor diagram of circuits with R, L, C, RL, RC, RLC for series configurations, Real power, reactive power, apparent power and power factor.

Three Phase circuits: Advantages of 3-phase power Circuits, Generation of 3-phase power, Three-phase balanced circuits, voltage and current relations in star and delta connections, Measurement of three phase power using two wattmeter method.

MODULE – 3

Single Phase Transformers: Necessity of transformer, Principle of operation, Types and construction of transformers, emf equation, losses, variation of losses with respect to load, efficiency, Condition for maximum efficiency.

Domestic Wiring: Service mains, Meter board and Distribution board, Brief discussion on concealed conduit wiring, Two-way and three-way control, Elementary discussion on circuit protective devices: Fuse and Miniature Circuit Breaker (MCB's), electric shock, precautions against shock, Earthing: Pipe and Plate earthing.

MODULE – 4

DC Generators: Principle of operation, Construction of D.C. Generators. Expression for induced emf, Types of D.C. Generators, Relation between induced emf and terminal voltage.

DC motors: Principle of operation, Back emf, Torque equation, Types of dc motors, Characteristics of dc motors (shunt and series motors only) and Applications.

MODULE – 5

Three Phase Synchronous Generators: Principle of operation, Constructional details, Synchronous speed, Frequency of generated voltage, emf equation, Concept of winding factor (excluding the derivation and calculation of distribution and pitch factors).

Three Phase Induction Motors: Principle of operation, Generation of rotating magnetic field, Construction and Working of three-phase induction motor, Slip and its significance, Necessity of starter, star-delta starter.

COURSE OUTCOMES:

After studying this course, students will be able to:

- Explain DC circuits and AC fundamental concepts.
- Analyze single phase AC circuits with R, L, C and behavior of three phase AC circuits.
- Explain the working of single phase transformer and concepts of electrical wiring circuit protecting devices and earthing.
- Discuss the principle of operation and construction of DC Machines.
- Describe the principle of operation and construction of AC Synchronous generators and three phase induction motors

Text Book:

1. Basic Electrical Engineering, D C Kulshreshtha, Tata McGraw Hill, Revised First Edition.
2. Principles of Electrical Engineering & Electronics, V.K. Mehta, Rohit Mehta, S. Chand, Publications.

Reference Books:

1. Fundamentals of Electrical Engineering and Electronic, B. L. Theraja, S. Chand & Company Ltd, Reprint Edition 2013.
2. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, 2017.
3. Electrical Technology, E. Hughes International Students 9th Edition, Pearson, 2005.

COMPUTER AIDED ENGINEERING DRAWING

Course Code: 22CED15/25	Credits: 03
Teaching Hours/Week (L:T:P): 1:0:4	CIE Marks: 50
Total Number of Teaching Hours: 56	SEE Marks: 50

Course Objectives: The basis of this course is to afford the knowledge of drafting skills, elevating conceptualization and practicality of the students.

Module-1(10 Hours)

Introduction to Computer Aided Sketching Standard tool bar / menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering. (Demonstration only)

Orthographic Projections:

Definitions - Planes of projection, reference line and conventions employed. Projections of points in all the four quadrants. Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes.

Module-2 (10 Hours)

Projection of Planes:

Projection of planes such as triangle, square, rectangle, pentagon, hexagon and circle resting on HP in different positions by change of position method only.

Module-3 (16 Hours)

Projection of Solids:

Projection of solids such as cube, prism, pyramid, cylinder, cone and tetrahedron (No problems on freely suspended prisms).

Module-4 (10 Hours)

Development of Surfaces:

Development of lateral surfaces of solids- Different prisms and pyramids, cylinder and cone.

Module-5 (10 Hours)

Isometric Projection:

Introduction to isometric scale, isometric projection of cube, prisms, pyramids, cones, spheres, cut spheres, frustums of cones and pyramids in simple positions, combination of solids (Maximum of two solids).

Miscellaneous Applications: (Lab practice only)

Drawing Simple Mechanisms: Bicycles, two wheeler cart, four wheeler, fan and Furniture. Electronics Engineering Drawings- Simple electrical and electronic circuits.

Sports: Drawing of different tool kits used.

Text Books:

1. Engineering Graphics – K.R. Gopalakrishna, 32nd edition, 2005- Subhash Publishers, Bangalore.
2. Engineering Drawing – N.D. Bhatt & V.M. Panchal, 48th edition, 2005- Charotar Publishing House, Gujarat.
3. A Primer on Computer Aided Engineering Drawing - Solution Book prepared by ACU.

Reference Books:

1. Computer Aided Engineering Drawing, S. Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition, 2006.
2. M. H. Annaiah, B. Sudheer Prem Kumar & C. N. Chandrappa, “Computer Aided Engineering Drawing”, New Age International (P) Ltd., 2016.

Evaluation Scheme					
Scheme	Weightage	Marks	Marks Break Up		
CIE	50%	50	Test	Sketch-book	Printouts
CIE	50%	50	Test	Sketch-book	Printouts

Module-1 is for practice & Internal Assessment only and not for SEE.			10	30	10
SEE	50%	50	Manual Drawing	Computer Printouts	
Module-2 to Module-5			34	16	

QUESTION PAPER PATTERN:

- Maximum of six questions will be set as per the following pattern.(No mixing of questions from different modules):

Question Paper Pattern			Scheme of Evaluation (in Marks)		
Scheme	Weightage	Marks	Marks Break Up	Marks	Marks
Q. No.	Module	Marks	Solutions & Sketching	Computer Display & Printout	Total Marks
1 or 2	2	20	20		20
3 or 4	3	50	30	20	50
5 or 6	4 or 5	30	18	12	30
TOTAL		100	68	32	100

NOTE: Students have to answer any one question from Module-2 [Only Sketching- Computer Printout not required - carrying 10 Marks] and one question each from Module-3 (25 Marks) and Module-4 or Module-5 (15 marks) respectively. [Includes Sketching (60% marks) and Computer Printout (40% marks)]

- SEE is to be conducted for 100 Marks and will be reduced to 50 Marks.

Course Outcomes:

At the end of the course, the student will be able to:

- CO1:** Apprehend the basics of engineering graphics and use of computer tools to create simple geometrical entities.
- CO2:** Ascertain the location of the object with respect to the planes of projection and draw its Orthographic views.
- CO3:** Draw the development and isometric projection of regular solids.

Semester	I/II	Course Title	Applied Physics Lab	Course Code	22PHYL-16/26
Teaching Period	28 Hours	L – T – P – TL	0 – 0 – 2 – 2	SEE	3 Hours
CIE	50 Marks	SEE	50 Marks	Total	100 Marks
CREDITS – 01					

COURSE OBJECTIVES:

- To realize experimentally, the mechanical, electrical and thermal properties of materials, concept of waves and oscillations.
- Design simple circuits and hence study the characteristics of semiconductor devices.

COURSE CONTENTS:

1. **Spring Constant** -Determination of spring constant and verification of series and parallel combination of springs.
2. Single Cantilever- Determination of the Young's modulus of the given material.
3. Torsional Pendulum - Determination of rigidity modulus & momentum of inertia of the given material.
4. Laser Diffraction – Determination of Wavelength of semiconductor laser using Laser diffraction.
5. Optical Fiber – Determination of acceptance angle and numerical aperture of an optical fiber.
6. Zener Diode - Study of Zener diode characteristics.
7. Fermi Energy- Determination of the Fermi energy of a given metal.
8. LCR Series and Parallel Resonance-Study the frequency response of series and parallel resonance circuit & Determination of self-inductance of a given coil.
9. Photodiode- Study of Photodiode characteristics.
10. Dielectric Constant- Determination of the dielectric constant of a material by charging and discharging method of a capacitor.
11. Black Body Radiator- Verify the Stefan's law of radiation.
12. Semiconductor - Determination of energy gap of a given semiconductor.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Recall the concepts of Interference of light, Diffraction of light, Total Internal reflection & Fermi energy.
- Understand the principles of operations of optical fibers and semiconductor devices such as photodiode, and NPN transistor using simple circuits.
- Determine elastic moduli and moment of inertia of given materials with the help of suggested procedures.
- Recognize the resonance concept and its practical applications.
- Understand the importance of measurement procedure, honest recording and representing the data, reproduction of results.

CONDUCTION OF PRACTICAL EXAMINATION:

- Any 10 experiments are mandatory. Student must perform two experiments in the SEE.

Semester	I / II	Course Title	Basic Electrical Engineering Lab	Course Code	22ELEL17/27
Teaching Period	28 Hours	L – T – P – TL*	0 – 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 01					

COURSE OBJECTIVES: This course will enable students

- To provide exposure to common electrical components such as Resistors, capacitors and inductors, types of wires and measuring instruments.
- To measure power and power factor measurement of different types of lamps and three phase circuits.
- To explain measurement of impedance for R-L and R-C circuits.
- To determine power consumed in a 3 phase load.
- To explain methods of controlling a lamp from different places.

Orientation class for an exposure to:

- Resistors, capacitors, inductors, rheostats, diodes, transistors, types of wires, measuring instruments – voltmeter, ammeter, wattmeter, multi-meter, Regulated power supply, Function generator, oscilloscope, transformer, dc motor, synchronous generator, three phase induction motor etc.
- Basic safety precautions while dealing with electricity.

LIST OF EXPERIMENTS:

1. Verification of KCL and KVL for DC circuits.
2. Measurement of current, power and power factor of incandescent lamp, fluorescent lamp, and LED lamp.
3. Measurement of resistance and inductance of a choke coil using 3 voltmeter method.
4. Determination of phase and line quantities in three phase star and delta connected loads.
5. Measurement of three phase power using two wattmeter method.
6. Two way and three way control of lamp and formation of truth table.
7. Measurement of Earth Resistance.
8. Study of effect of open and short circuit in simple circuits

9. Half Wave and Full Wave Rectifier.
10. Design of inverting, non-inverting and voltage follower using Op-amp.

DEMONSTRATION EXPERIMENTS (FOR CIE ONLY):

1. Demonstration of fuse, MCB by creating a fault.
2. Demonstration of cut-out sections of electrical machines (DC machines, Induction machines and synchronous machines)
3. Understanding ac and dc supply, use of tester and test lamp to ascertain the healthy status of mains.
4. Understanding of UPS.

COURSE OUTCOMES:

At the end of the course the student will be able to:

- Apply the knowledge of KVL and KCL.
- Computing the ripple factor and efficiency of half wave and full wave rectifier and computing the impedance of a choke coil.
- Applying the knowledge of three phase loads to verify the relationship between line and phase quantities in star and delta connected loads and measurement of three phase power.
- Experiment of two way and three way controlling of lamp and identifying the power consumption and determining the power factor of different lamps.
- Examining the effects of open and short circuit in simple circuits and earth resistance.
- Identify the different electrical components and measuring instruments used for conducting experiments.

Semester	I	Course Title	Communicative English-I	Course Code	22AEC18
Teaching Period	50 Hours	L – T – P – TL	3 – 2 – 0 - 5	SEE	3 Hours
CIE	50 Marks	SEE	50Marks	Total	100 Marks
CREDITS - 01					

COURSE OBJECTIVES:

The course will enable the students,

- To know about Fundamentals of Communicative English and Communication Skills in general.
- To train to identify the nuances of phonetics, intonation and enhance pronunciation skills for better communication skills.
- To impart basic English grammar and essentials of important language skills.
- To enhance English vocabulary and language proficiency for better communication skills.
- To learn about Techniques of Information Transfer through presentation.

COURSE CONTENTS:

: MODULE-1: (10Hours)

Introduction to Communicative English:

Introduction, Language as a Tool, Fundamentals of Communicative English, Process of Communication, Barriers to Effective Communicative English, Different styles and levels in Communicative English (Communication Channels). Interpersonal and Intrapersonal Communication Skills, How to improve and Develop Interpersonal and Intrapersonal Communication Skills.

: MODULE-2:(10Hours)

Introduction to Phonetics:

Introduction, Phonetic Transcription, English Pronunciation, Pronunciation Guidelines Related to consonants and vowels, Sounds Mispronounced, Silent and Non-silent Letters, Syllables and Structure, Word Accent and Stress Shift, – Rules for Word Accent, Intonation – purposes of intonation, Spelling Rules and Words often Misspelt – Exercises on it. Common Errors in Pronunciation.

: MODULE-3: (10Hours)

Basic English Communicative Grammar and Vocabulary PART - I :

Grammar: Basic English Grammar and Parts of Speech - Nouns, Pronouns, Adjectives, Verbs, Adverbs, Conjunctions, Articles and Preposition. Preposition, kinds of Preposition and Prepositions often Confused.

Articles: Use of Articles Indefinite and Definite Articles, Pronunciation of 'The', wordsending 'age', some plural forms. Introduction to Vocabulary, All Types of Vocabulary –Exercises on it.

: MODULE-4: (10Hours)

Basic English Communicative Grammar and Vocabulary PART - II:

Question Tags, Question Tags for Assertive Sentences (Statements) – Some Exceptions in Question Tags and Exercises, One Word Substitutes and Exercises. Strong and Weak forms of words, Words formation - Prefixes and Suffixes (Vocabulary), Contractions and Abbreviations. Word Pairs (Minimal Pairs) – Exercises, Tense and Types of tenses, The Sequence of Tenses (Rules in use of Tenses) and Exercises on it.

: MODULE-5: (10Hours)

Communication Skills for Employment:

Information Transfer: Oral Presentation - Examples and Practice. Extempore / Public Speaking, Difference between Extempore / Public Speaking, Communication Guidelines for Practice. Mother Tongue Influence (MTI) – South Indian Speakers, Various Techniques for Neutralization of Mother Tongue Influence – Exercises. Reading and Listening Comprehensions – Exercises.

Course Outcomes:

At the end of the course the student will be able:

1. Understand and apply the Fundamentals of Communication Skills in their communication skills.
2. Identify the nuances of phonetics, intonation and enhance pronunciation skills.
3. To impart basic English grammar and essentials of language skills as per present requirement.
4. Understand and use all types of English vocabulary and language proficiency.

5. Adopt the Techniques of Information Transfer through presentation.

QUESTION PAPER PATTERN:

Note: - The SEE question paper will be set for 100 marks and the marks scored by the student will be finally reduced to 50.

- The question paper will have fifty multiple choice questions carrying equal marks.
- Each full question carries 1 mark.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer fifty full questions, selecting one full question from each module.

Text books:

1. Communicative English I by Zestech Global Pvt Ltd

Semester	I / II	Course Title	DATA SCIENCE	Course Code	22DS19/29
Teaching Period	15 Hours	L – T – P – TL*	0 – 0 – 2 – 2	Exam Hours	02 Hrs
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS-01					

***NOTE:** L – Lecture; T – Tutorial; P – Practical; TL – Total;

CIE – Continuous Internal Evaluation; **SEE** – Semester End Examination

COURSE OBJECTIVES:

- To acquire programming skills in core Python.
- To learn how to write loops and decision statements in Python.
- To develop the skill of designing Graphical user Interfaces in Python

COURSE CONTENTS:

Implement the programs with WINDOWS / LINUX platform using Python

1. Write a Python program to find sum and average of two numbers?
2. Write a Python program to convert temperature in Celsius to Fahrenheit.
3. Write a Python program to check whether a given number is prime or not.
4. Write a Python program to find length of string and to convert upper to lower case of a string.
5. Write a program to count a number of vowels in a string.
6. Write a Python program to create an array of 5 integers and display an array.
7. Write a Python program to plot bar graph using labels of languages ‘C’, ‘C++’, ‘Java’, ‘Python’, ‘PHP’ and students’ marks scored in above languages.
8. Write a Python program to plot pie chart using labels of brands of cars ‘AUDI’, ‘BMW’, ‘FORD’, ‘TESLA’, ‘JAGUAR’, ‘MERCEDES’ and sales of the cars.

EXAMINATION GUIDELINES:

- Students are allowed to pick one experiment from the lot of 8 programs and provide equal opportunity.

- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted for write up will be deducted.

Semester	I / II	Course Title	Applied Chemistry	Course Code	22CHE-12/22
Teaching Period	50 Hours	L – T – P – TL	3 – 1 – 0 – 4	SEE	3 Hours
CIE	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 03					

COURSE OBJECTIVES:

This course (22CHE - 12/22) will enable students to

- Master the basic knowledge of engineering chemistry for building technical competence in industries, research, and development.
- Impart the basic knowledge of chemistry and its principles involved in electrochemistry, Battery technology and its applications.
- Identifying and analyzing engineering problems related to metallic corrosion, achieving practical solutions for corrosion control and surface modifications of materials for engineering applications.
- Apply the knowledge of Green Chemistry, principles for production of chemical compounds.
- Master the knowledge of synthesis, properties, and utilization of engineering materials like polymers & Nano materials.

COURSE CONTENTS:

MODULE – 1 (10 Hours)

Electrochemistry and Battery technology

Electrochemistry: Introduction, Derivation of Nernst equation for single electrode potential, Reference electrodes; Introduction, construction, working and applications of calomel electrode and Ag/AgCl electrodes. Ion-selective electrode-Definition, construction and principle of glass electrode and determination of pH using glass electrode. Electrolyte concentration cells-definition, derivation of equation to find the emf of concentration cells, numerical problems on concentration cell.

Battery technology: Introduction, characteristics, classification-primary, secondary, and reserve batteries. Construction, working and application of Zinc-Air, Ni-MH and Li-ion batteries.

Fuel cells: Introduction, differences between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H₂SO₄ electrolyte.

MODULE – 2 (10 Hours)

Corrosion science and Metal finishing

Corrosion: Introduction, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: anodic and cathodic areas, nature of corrosion product, nature of medium-pH, conductivity and temperature. Types of corrosion – Differential metal and differential aeration-pitting and water line) and stress (Caustic embrittlement in boilers).

Corrosion control: Anodizing-Anodizing of aluminum and phosphating, cathodic protection-sacrificial anode and impressed current methods, Metal Coatings-Galvanization and Tinning.

Metal finishing: Introduction, Technological importance of metal finishing. Factors governing electroplating-Polarization, Decomposition potential and Over voltage. Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electroless plating: Introduction, distinction between electroplating and electroless plating processes. Electroless plating of copper.

MODULE – 3 (10 Hours)

Chemical fuels and Solar energy

Chemical Fuels: Introduction, Classification, definitions of CV, LCV and HCV, determination of calorific value of solid/liquid fuel using bomb calorimeter, numerical problems. Knocking of petrol engine- definition, mechanism, ill effects and prevention. Octane and cetane number. Leaded petrol, unleaded petrol, Power alcohol and biodiesel.

Solar energy: Photovoltaic cells-introduction, construction and working of a typical PV cell, Preparation of solar grade silicon by Union Carbide process/ Method. Advantages & disadvantages of PV cell.

MODULE – 4 (10 Hours)

Green Chemistry and Water chemistry

Green Chemistry: Introduction, definition, Major environmental pollutants-Oxides of Nitrogen, Sulphur and Carbon (Source, effect and control), Basic principles of green chemistry-brief discussion on 12 principles of green chemistry. Various green chemical approaches-Microwave synthesis, Bio catalysed reaction (only explanation with examples), Solvent-free reactions-advantages and conditions Synthesis of typical organic compounds by conventional and green route; i) Adipic acid ii) Paracetamol. Industrial applications of green chemistry.

Water chemistry: Introduction, sources and impurities of water; boiler feed water, boiler troubles with disadvantages -scale and sludge formation, boiler corrosion (due to dissolved O₂, CO₂ and MgCl₂). Sources of water pollution, Definitions of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), determination of COD, numerical problems on COD. Sewage treatment: primary, secondary (activated sludge) and tertiary methods. Softening of water by ion exchange process. Desalination of sea water by reverse osmosis.

MODULE – 5 (10 Hours)

Engineering Materials

Polymer: Introduction, types of polymerization-addition and condensation polymers. Mechanism of polymerization-free radical mechanism taking vinyl chloride as an example. Molecular weight of polymers: number average and weight average Numerical problems, Synthesis and applications of Polyurethanes. Synthesis, properties and applications of Epoxy resin and Silicon rubber.

Biodegradable polymers: Introduction and their requirements. Synthesis, properties and applications of Poly lactic acid.

Nanomaterials: Introduction, size dependent properties (Surface area, Electrical, Optical, catalytic and Thermal properties) Synthesis of nanomaterials: Top down and bottom-up approaches, Synthesis by Sol- gel, and precipitation method, Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes- brief Explanation, properties, and applications.

Upon completion of this course, students will be able to

- Apply the knowledge of electrochemistry to improve the efficiency of batteries.
- Interpret the reasons of corrosion, monitor and control by using the proper techniques.
- Understanding theoretical knowledge on fuels like petrol and diesel and its drawbacks in engines, Have concept on rearing high octane quality fuels.
- Explain the principles of green chemistry, develop innovative methods to produce soft water for industrial use and potable at cheaper cost.
- Knowledge on synthesis nano materials and its basic properties and applicability. Polymers for various applications.

RECOMMENDED LEARNING RESOURCES:

Textbooks:

- P.C. Jain & Monica Jain. “Engineering chemistry”, Dhanpat Rai publications, New Delhi (2015- Edition).
- S.S.Dara, A textbook of Engineering Chemistry, 10th Edition, S Chand &Co., Ltd., New Dehli,2014.
- Physical Chemistry, by P.W. Atkins, Oxford Publications (Eighth edition-2006).

Reference books:

- O.G.Palanna, “Engineering Chemistry”, Tata McGraw Hill Education Pvt Ltd. New Delhi, fourth Reprint (2015-Edition).
- R.V.Gadag & A. Nityananda shetty. “Engineering Chemistry”, I K International Publishing House Private Ltd. New Delh (2015-Edition).
- “Wiley Engineering chemistry”, Wiley India Pvt. Ltd. New Delhi. Second Edition-2013.
- B.Jaiprakash, R.Venugopal, Shivakumaraiah and Pushpa Iyengar, Chemistry for Engineering students, Subhash Publications, Bengaluru,(2015-Edition).
- M.G. Fontana, N.D. Greene, Corrosion Engineering, McGraw Hill Publications, New York, 3rd Edition, 1996.
- G.A.Ozin & A.C.Arsenault, Nanotechnology A Chemical Approach to Nanomaterials. RSC Publishing, 2005.

QUESTION PAPER PATTERN:

- The question paper will have ten full questions carrying equal marks.
- Each full question consisting of 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Semester	I / II	Course Title	Programming in C Language	Course Code	22PCL13/23
Teaching Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 4	Exam Hours	03 Hrs.
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS-03					

***NOTE:** L – Lecture; T – Tutorial; P – Practical; TL – Total;
CIE – Continuous Internal Evaluation; **SEE** – Semester End Examination.

COURSE OBJECTIVES:

The objectives of this course are to make students to learn basic principles of Problem solving, implementing through C programming language and to design & develop programming skills.

COURSE CONTENTS:

Introduction to C language:

::MODULE – 1::

Introduction to computing, Constants, variables, Data types, operators and expressions, Input and output operations.

Textbook 1: Chapter 1, 3, 4, 5

Decision making & Branching:

Introduction, Decision making with if statement, simple if statement, the if-else statement, nesting of if-else statement, the else-if ladder, the switch statement, ternary operator? Goto statement, Programming examples and exercises.

::MODULE – 2::

Looping:

Introduction, the while statement, the do statement, the for statement, break and continue, Programming examples and Exercises.

Textbook 1: Chapter 7

Arrays: Introduction, One-dimensional array, Declaration of One-Dimensional arrays, Initialization of one-dimensional arrays programming examples (Linear search, binary search, bubble sort, selection sort), Two-dimensional arrays, Initialization of two-dimensional arrays, programming examples (Addition of two matrices, multiplication of two matrix)

Textbook 1: Chapter 8 10 Hours

::MODULE – 3::

Strings:

Introduction, Declaring and Initializing string variables, Reading and writing strings, String handling functions, String input and output functions, Array of strings.

Textbook 1: Chapter 9

Functions:

Introduction, need for user-defined functions, elements of user defined function, Definition of functions, parameter passing mechanisms: Call by value and call by reference, Category of functions, nesting of functions. Passing arrays to functions.

Textbook 1: Chapter 10

Textbook 2: Chapter 14.3 10 Hours

::MODULE – 4::

Preprocessors:

Introduction to Preprocessors, macro substitution, file inclusion, compiler control Directives, Programming examples and Exercises.

Textbook 1: Chapter 15

Structures: Introduction, defining a structure, declaring a structure, accessing a structure member, structure initialization, copying and comparing structure variables, Array of structures, arrays within structures, structure within structures.

Unions: Union definition, declaration.

Textbook 1: Chapter 11 10 Hours

::MODULE – 5::

Pointers:

Introduction to pointers, pointers and arrays, pointers and strings, pointer and structure, Allocating Memory at Runtime.

Textbook 3: Chapter 1, Chapter 2 (Page No 43 to 49),

Chapter 3(Page No 133 to 137) Chapter 4(Page No 189 to 200)

Textbook 2: Chapter 17.9

File Management:

Introduction, Defining and opening a File, Closing a File, Input/output operations on Files, Error Handling during I/O Operations, Random Access to Files.

Textbook 1: Chapter 13 10 Hours

COURSE OUTCOMES:

The student will be able to:

- Identify basic elements of c programming structures like data types expressions.
- Code Identify basic elements of C programming structures like control statements, various simple functions and in view of using them in problem solving.
- Apply various operations on derived data types like arrays and strings.
- Apply various operations on derived data types like preprocessing, functions problem solving.
- Implement user defined data structures used in specific applications.

RECOMMENDED LEARNING RESOURCES:

Text Books:

1. E. Balagurusamy, “Programming in ANSI C”, Eighth Edition McGraw-Hill
2. Vikas Gupta: Computer Concepts and C Programming, Dreamtech Press 2013.
3. Yashavant kanetkar: “Understanding Pointer in C” Third Edition 2005.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie: The C Programming Language, 2nd Edition, PHI, 2012.
2. R S Bichkar, Programming with C, University Press, 2012.
3. V Rajaraman: Computer Programming in C, PHI, 2013.
4. Byron Gott Fried & Schaum’s Outlines Programming with C, 2nd Edition, McGraw-Hill.

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full question consisting of 20 marks.
- There will be Three sub-questions from each module.
- Students will have to answer five full questions, selecting one full question from each module.

Semester	I / II	Course Title	Basic Electronics	Course Code	22ELN14/24
Teaching Period	42 Hours	L – T – P – TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives: This course will enable students

1. To understand the principles and operation of semiconductor devices, circuits and communication system.
2. To demonstrate the ability to solve problems on analog and digital circuits.
3. To analyze the circuits by applying the knowledge of devices and circuits.

MODULE – 1

Digital fundamentals

Number System- Binary, Hexadecimal, Conversion Decimal to binary, Hexadecimal to decimal and vice-versa, Binary addition and subtraction using 1's and 2's complement method, Review of logic gates, NAND as universal gate (as OR, AND & NOT), Boolean Algebra, Demorgan's theorems, Simplification and realization of Boolean expressions using basic gates and NAND gates, Half adder, Full adder and Parallel adder.

MODULE – 2

Semiconductor diode and its applications

Semiconductor Diodes: PN-junction diode, VI characteristics and parameters of a PN junction diode, applications –Half wave rectifier, Full wave rectifier, Capacitor filter.

Zener diode: Working, VI characteristics, Zener diode as voltage regulator.

MODULE – 3

Transistors and its applications

Bipolar junction transistor, CE configurations and characteristics, DC load line and operating point, BJT as an amplifier and switch. Field-Effect Transistors: Depletion-Type MOSFET, Enhancement- Type MOSFET. Construction & Characteristic of JFET, Silicon Controlled Rectifier (SCR), Two Transistor Model, Switching Action.

MODULE – 4

Operational Amplifier and Oscillators

Operational amplifier: Block diagram of an Operational amplifier, Characteristics of an ideal operational amplifier, Concept of virtual ground, Inverting and non-inverting amplifier, Voltage follower, Adder, Subtractor, Integrator and differentiator.

Oscillators: Concept of feedback, Barkhausen's Criteria, Types of Oscillators- Wein Bridge Oscillator and RC phase shift Oscillator.

MODULE – 5

Communication System

Block diagram of communication system, Need for modulation, Definition of modulation, Amplitude modulation: Definition and waveforms, Expression for AM, Modulation index.

Frequency Modulation: Definition and waveforms (Qualitative analysis), Modulation index, Comparison of AM and FM, Principle of operation of Mobile Phone, Microwave Communication, Optical fibre communication.

Course Outcomes:

After studying this course the student should be able to:

- Apply the knowledge of engineering fundamentals to analyze and design digital circuits.
- Explain the construction, operation and applications of Diode.
- Describe the construction and working of devices and circuits.
- Explain the concept of feedback and design op-amp for various applications.
- Describe the basic principles of communication system and mobile phones.

Text Book:

1. Robert L. Boylestad, Louis Nashelsky “ Electronic devices and circuit theory” PHI Publication, 11th Edition, 2012.
2. D P Kothari, I J Nagrath “Basic Electronics”, McGraw Hill Education, 2014. ISBN: 978-93-329- 0158-2.

Reference Books:

1. Thomas L Floyd, “Electronic Devices”, Pearson Education, 9th edition, 2012.
2. George Kennedy “Electronic Communication System”, TMH Publication, 5th Edition, 2015.
3. Donald D. Givone “ Digital principles and design” TMH Publication, 2003.

ELEMENTS OF MECHANICAL ENGINEERING

Course Code	22EME15/25	CIE Marks	50
Teaching Hour/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Teaching- Learning	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

1. Acquire a basic understanding role of Mechanical Engineering in the industry and society.
2. Acquire a basic understanding of energy resources and basic concepts of Hydraulic turbines.
3. Acquire knowledge of various engineering materials and metal joining techniques.
4. Acquire knowledge on automobile technology in transport application and basics of Refrigeration and Air-Conditioning.
5. Acquire essential experience on basic Power transmission systems, robotics and automation.
6. Acquire knowledge of basic concepts on manufacturing principles and machine tools and their Advancement.

Teaching-Learning Process (General Instruction):

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module 1 (8 Hours)

Energy Sources and Power Plants:

Review of energy sources; Construction and working of Hydel power plant, Solar power plant, Tidal power plant, Wind power plant.

Introduction to basics of turbines and pumps:

Principle and Operation of Hydraulic turbines: Pelton Wheel and Kaplan Turbine. Principle and Operation of Steam turbines: Impulse and Reaction Turbine.

Principle and Operation of Gas turbines: Open and Closed gas Turbine. Introduction to working of Centrifugal Pump.

Laboratory Components:

1. Visit any one Conventional or Renewable Energy Power Plant and prepare a comprehensive report.
2. Demonstration of Components of any one Turbo-machine through Cut Sections.

Teaching- Learning Process

1. Power-point Presentation,
2. Video demonstration or Simulations,
3. Laboratory Demonstrations and Practical Experiments Module 2 (8 Hours)

Engineering Materials

Ferrous Metals: Cast iron and its types, Steel: Mild steel and Medium carbon steel.

Non-ferrous Metals: Aluminum, Copper and its alloys.

Smart materials- Piezoelectric materials, shape memory alloys, semiconductors, and super- insulators.

Metal Joining Processes:

Soldering, Brazing and Welding: Definitions. Classification and methods of soldering, brazing, and welding. Brief description of arc welding, Electrodes used in arc welding Oxy-acetylene welding, types of flames.

Laboratory Components

1. One exercise each involving Welding, Soldering, and Brazing.
2. Study oxy-acetylene gas flame structure and its application to gas welding

Teaching- Learning Process

1. PowerPoint Presentation
2. Video demonstration or Simulations
3. Laboratory Demonstrations and Practical Experiments

Module 3 (8 Hours)

Fundamentals of IC Engines (self study)

Review of Internal Combustion Engines, 2-Stroke and 4-Stroke engines, Components and working principles, Performance parameters.

Insight into future mobility technology: Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles, Drives and Transmission. Advantages and disadvantages of EVs and Hybrid vehicles.

Refrigeration and Air-Conditioning:

Principle of refrigeration, Refrigeration effect, Ton of Refrigeration, COP, Refrigerants and their desirable properties. Principles and Operation of Vapour Compression and Vapour absorption Refrigeration. Working Principles of Air Conditioning, Classification, and Applications of Air Conditioners. Concept and operation of room air conditioning system.

Laboratory Components:

1. Study of Engine Components through Cut Sections
2. Demonstrate Components and Working principles of Domestic Refrigerator and prepare a comprehensive report OR Study/visit any commercial centralized Air-Conditioning unit, understand various components and operations, and prepare a comprehensive report.

Teaching- Learning Process

1. PowerPoint Presentation.
2. Video demonstration or Simulations.
3. Laboratory Demonstrations and Practical Experiments.

Module 4 (8 Hours)

Power Transmission:

Gear Drives: Types - spur, helical, bevel, worm and rack and pinion, velocity ratio, Numerical problems on Simple Gear trains

Belt Drives: Components of belt drive and concept of velocity ratio; Types of belt drives- Flat- Belt Drive and V-Belt Drive with Application. Simple numerical on Belt drives involving velocity ratios. Fundamentals of Machine

Tools and Operations:

Working Principle of Lathe and Operations: Turning, Facing, Thread Cutting, Taper Turning and Knurling.

Working Principle of Grinding Operations: Surface, Cylindrical and Centerless Grinding. Working Principle of Drilling Machine and operations: Reaming, Boring, Tapping, Counter Boring, Counter Sinking.

Laboratory Components:

1. Demonstration of the machine consists of Gear Trains.
2. Demonstration of developing one model involving Lathe, Grinding and Drilling.

Teaching- Learning Process

1. PowerPoint Presentation,
2. Chalk and Talk are used for Problem Solving.
3. Video demonstration or Simulations.

Module 5 (8 Hours)

Introduction to Mechatronics: Concept of open-loop and closed-loop systems, Examples of Mechatronic systems and their working principle.

Introduction to Robotics and Automation:

Robot anatomy, Joints & links, common Robot configurations. Applications of Robotics in Material Handling, Processing, Assembly, and Inspection. Automation types, NC machines, CNC machines.

Laboratory Components:

1. Carry out a Case study on anyone Mechatronics device and prepare a comprehensive report.
2. Demonstration of any one model of Robot

Teaching- Learning Process

1. PowerPoint Presentation,
2. Students are encouraged to practice only line diagrams for exams.
3. Video demonstration or Simulations,
4. Laboratory Demonstrations and Practical Experiments

Course Outcomes:

At the end of the course, the student will be able to:

- CO1** Comprehend the basic knowledge of mechanical engineering in energy and its utilization, materials technology, manufacturing techniques, and transmission systems through demonstrations.
- CO2** Recognize the application of energy sources in Power generation and utilization of Engineering materials in manufacturing.
- CO3** Apply the skills in developing simple mechanical elements and processes.

Suggested Learning Resources:

Books:

1. Elements of Mechanical Engineering, K R Gopala Krishna, Subhash Publications, 2015.
2. Elements of Workshop Technology (Vol. 1 and 2), Hazra Choudhry and Nirzar Roy, Media Promoters and Publishers Pvt. Ltd., 2010.
3. An Introduction to Mechanical Engineering, Jonathan Wickert and Kemper Lewis, Third Edition, 2012
4. Turbo Machines, M. S. Govindgowda and A. M. Nagaraj, M. M. Publications 7Th Ed, 2012
5. Robotics, Appu Kuttan KK, K. International Pvt Ltd, volume 1 9.

Additional References:

- Elements of Mechanical Engineering , S.Trambaka Murthy, IK International Publishing Pvt.ltd., 2010.
- Manufacturing Technology- Foundry, Forming and Welding, P.N.Rao Tata McGraw Hill 3rd Ed., 2003.

Semester	I / II	Course Title	Applied Chemistry lab	Course Code	22CHEL-16/26
Teaching Period	28 Hours	L – T – P – TL	0 – 0 – 2 – 2	SEE	3 Hours
CIE	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 01					

COURSE OBJECTIVES:

- Quantitative analysis of materials by volumetric and chemical method.
- Instrumental methods for developing experimental skills in building technical competence

Part A: Instrumental Experiments

1. Estimation of FAS Potentiometrically using standard $K_2Cr_2O_7$ solution.
2. Estimation of Acids in acid mixture Conductometrically.
3. Determination of Viscosity co-efficient of a given liquid using Ostwald's viscometer.
4. Estimation of copper by Colorimeter.
5. Determination of pKa value of a given weak acid using pH meter.

Part B: Volumetric Experiments

1. Estimation of Total hardness of water by EDTA complexometric method.
2. Estimation of CaO in cement solution by rapid EDTA method.
3. Determination of percentage of Copper in brass using standard sodium thiosulphate solution.
4. Determination of COD of industrial waste water.
5. Estimation of percentage of Iron in given haematite ore solution using standard $K_2Cr_2O_7$ solution (External indicator method).

Course outcomes:

On completion of this course, students will have the knowledge in,

- Handling different types of instruments for analysis of materials using small quantities of materials involved for quick and accurate results.
- Carrying out different types of titrations for estimation of concerned in materials using comparatively more quantities of materials involved for good results.

CONDUCTION OF PRACTICAL EXAMINATION:

- All 10 experiments are mandatory. Student has to perform two experiments in the SEE.

Text Books:

1. Vogel's A.I. A text book of quantitative analysis, 35th edition, 2012.
2. Willard, Merit, Dean and Settle, A text book of Instrumental analysis, 6th edition 2012.

Reference books:

1. G.H Jeffery, J Bassett, J Mendham and R.C. Denney Vogel's A.I. A text book of quantitative analysis, Dorling Kindersley (India) Pvt., Ltd. 35th edition, 2012.
2. Gary D Christian, Analytical Chemistry, Wiley India, 6th edition, 2015.

Semester	I / II	Course Title	Computer Programming Laboratory	Course Code	22CPL17/27
Teaching Period	42 Hours	L – T – P – TL*	0 – 1 – 2 – 3	Exam Hours	03 Hrs
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS-01					

***NOTE:** L – Lecture; T – Tutorial; P – Practical; TL – Total;
CIE – Continuous Internal Evaluation; **SEE** – Semester End Examination

COURSE OBJECTIVES:

- To practice writing flowcharts, algorithms and programs.
- To implement basics of C programming language.
- To provide solutions to the laboratory programs.
- To familiarize the processes of debugging and execution.

COURSE CONTENTS:

1. Develop an algorithm and implement simple C program to solve simple computational problems using arithmetic expressions, demonstrate familiarization with programming environment, concept of naming the program files, storing, compilation and debugging, using different data types.
2. Draw the flowchart and implement a simple C program to solve problems involving if-then-else structures to find the largest of given three positive integers.
3. Design and develop a flowchart or an algorithm that takes three coefficients (a, b, and c) of a Quadratic equation ($ax^2+bx+c=0$) as input and compute all possible roots. Implement a C program for the developed flowchart/algorithm and execute the same to output the possible roots for a given set of coefficients with appropriate messages. (Using switch statement).
4. Design and develop an algorithm to find the reverse of an integer number NUM and check whether it is PALINDROME or NOT. Implement a C program for the developed algorithm that takes an integer number as input

and output the reverse of the same with suitable messages. Ex: Num: 2014, Reverse: 4102, Not a Palindrome.

5. Draw the flowchart and Write C Program to compute $\sin(x)$ using Taylor series approximation given by $\sin(x) = x - (x^3/3!) + (x^5/5!) - (x^7/7!) + \dots$. Compare the result with the built-in Library function and print both the results with appropriate messages.
6. Develop an algorithm, implement and execute a C program that reads N integer numbers and arrange them in ascending order using Bubble Sort.
7. Develop, implement and execute a C program that reads two matrices A (m x n) and B (p x q) and Compute the product A and B. Read matrix A and matrix B in row major order and in column major order respectively. Print both the input matrices and resultant matrix with suitable headings and output should be in matrix format only. Program must check the compatibility of orders of the matrices for multiplication. Report appropriate message in case of incompatibility.
8. Draw the flowchart and write a recursive C function to find the factorial of a number, n!, defined by $\text{fact}(n)=1$, if $n=0$. Otherwise $\text{fact}(n)=n*\text{fact}(n-1)$. Using this function, write a C program to compute the binomial coefficient nCr . Tabulate the results for different values of n and r with suitable messages.
9. Implement structures to read, write, and compute average- marks and the students scoring above and below the average marks for a class of 60 students.
10. Write and execute a C program that:
 - i. Implement string copy operation STRCPY (str1, str2) that copies a string str1 to another string str2 without using library function.
 - ii. Reads a sentence and prints frequency of each of the vowels and total count of consonants using user defined functions.
11. Develop, implement and execute a C program to search a Name in a list of names using Binary searching Technique.

12. Write a C program to find the sum and average of N floating point numbers using pointer.

13. Write a C Program to first read from the file and then append the data of the file.

COURSE OUTCOMES:

The student should be able to:

- Execute C Program on control structures.
- Execute C programs using arrays and functions.
- Execute C programs on string handling functions.
- Execute C programs on pointers, structures and files.

EXAMINATION GUIDELINES:

NOTE: Program-1 is only for the practice & internal assessment not for SEE.

- Students are allowed to pick one experiment from the lot of 12 programs and provide equal opportunity.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted for write up will be deducted.

Semester	I/II	Course Title	Biology for Engineers	Course Code	22 BIO29
Teaching Period	16 Hours	L – T – P – TL*	1 – 0 – 0 – 0	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 01					

Module 1

Why Should Engineers Know Biology? Introduction, Need For Biology, Shinkansen Sonic Boom, For Our Wellness—We are All Biological Entities, Learning Biology is, Fundamentally Not Different, From Learning Mathematics.

Life-Its Origin and Evolution on Earth: Introduction, Why are the Surgical Instruments Sterilized Before Use? What is Life? Cell—The Fundamental Functional Unit of Life, Cells in the Human Body, The Scientific View on the, Origin of Life on Earth, What is Evolution?

Module 2

The Fundamental Molecules of Life-1: Introduction, Bioreactors, Shear in Bioreactors and its Effect on Productivity, What Gets Affected by Shear in Cells? A Typical Eukaryotic Cell Contains Many Parts Tightly Packed Inside it, What Constitutes the Cell (Plasma) Membrane,, Microscopically Speaking? Molecules that Comprise the Cell (Plasma) Membrane, Cell Membrane Functions, Lipids-One of the Four Fundamental Biomolecules, Lipids-The Human Angle.

The Fundamental Molecules of Life-2: Introduction, How is Curd/Yogurt Made at Home? Why Does Milk Turn into Curd? What is the Source of the Acid? Carbohydrates-The Second of the four Fundamental, Biomolecules, Action at a Molecular Level, Water and its Biological, Casein and Curd Formation , Significance of Carbohydrates in the Human Body, Bioenergy

Module 3

The Fundamental Molecules of Life-3: Introduction, Casein is a Protein, Amino Acids and Their Polymers, Structure of Proteins-The Third, Structure-Function Relationship and Significance, Role of Proteins in the Cell and its Membrane, Role of Proteins in the Human Body, Enzymes are Mostly Proteins, Enzymes Used in the Industry, Quantification of Enzyme, Activity and Kinetics of the Four Fundamental Biomolecules

The Fundamental Molecules of Life—4: Introduction , How Does the Cell Get the Energy Needed for its Various Processes?, Nucleic Acids—The Fourth of the Four Fundamental Biomolecules, Phosphorylation of ADP to ATP, Substrate Level Phosphorylation, Electron Transport Phosphorylation, Where do Phosphorylations Take Place in a Cell?, Polymers of Nucleotides—DNA, RNA Structural Aspects of DNA and RNA, Where and in What Form is DNA Present in the Cell?

Module 4

DNA Replication: Introduction, Separation of Strands, Replication Bubble, and Forks Priming, Addition of New Monomers (DNA Elongation) and Directionality Leading and Lagging Strands and Okazaki Fragments, Problem at the Ends of, Non-Circular DNA Proofreading and Repair of DNA Cell Replication and Its Quantification: Introduction, DNA Replication in a Cell- Part of the Cell Cycle, Steps in a Cell Cycle, Why Should Cells Replicate?, Quantification of Cell Division, Chromosomes in the Cell, All Cells Undergo Mitosis, Germ Cells Undergo Both Mitosis and Meiosis.

Module 5

How are Proteins Made in the Cell? Transcription and Translation: Introduction, The Central Dogma, Overview-Transcription and Translation Processes, The Genetic Code, Transcription-Initiation, Elongation, and Termination, Initiation, Elongation, Termination, Modifications to the Eukaryotic, Pre-mRNA, Cut-Paste, Translation- Initiation, Elongation, and Termination, Initiation, Elongation of the Polypeptide Chain, Termination, Post-Translational Modifications, Protein Targeting, Mutations and Their Outcomes, Mutation—The Molecular Mechanism of Evolution and, the Core of Genetic Engineering.

Mendelian Genetics as a Useful Tool: Introduction, Common Genetic Disorders in India, Common Genetic Disorders, Across the World, Mendelian Genetics—The First Approximation Tool to Predict Genetic Disorders in the Offspring, Essentials of Mendelian Genetics, Probabilities of Occurrence in Mendelian Genetics, Pedigree Analysis, Sex-Linked Inheritance, Non-Mendelian Inheritance

Text Books

1. “Biology for Engineers”, G K Suraishkumar, Oxford University Press.

Semester	II	Course Title	Engineering Mathematics - II	Course Code	22MAT21
Teaching Period	50 Hours	L – T – P – TL	3 – 2 – 0 - 5	SEE	3 Hours
CIE	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 04					

COURSE OBJECTIVES:

The purpose of the course is to enable the students with concrete foundation of vector calculus, ordinary and partial differential equations, infinite series, and numerical methods enabling them to acquire the knowledge of these mathematical tools.

COURSE CONTENTS:

: MODULE-1: (10Hours)

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrotational vector fields- Illustrative problems.

Vector Integration: Line Integrals, Theorems of Green, Gauss, and Stokes (without proof) problems only.

: MODULE-2:(10Hours)

Differential Equations of higher order: Second order linear ODE's with constant coefficients-Inverse differential operators, method of variation of parameters and; Cauchy's and Legendre homogeneous equations. Applications of a spring and L-C-R circuits.

: MODULE-3:(10Hours)

Partial Differential Equations (PDE's): Formation of PDE's by elimination of arbitrary constants / functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Derivation of one-dimensional heat and wave equations and solutions by the method of separation of variables.

: MODULE-4:(10Hours)

Infinite Series: Series of Positive Terms- Convergence and divergence of infinite series. Cauchy's root test and D'Alembert's ratio test (without proof) - Illustrative examples.

Power series solutions: Series solution of Bessel's differential equation leading to $J_0(x)$ -Bessel's function of first kind orthogonality

: MODULE-5:(10Hours)

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples.

Numerical integration: Simpson's (1/3)rd and (3/8)th rules, Weddle's rule (without proof) – Problems.

Course Outcomes:

On completion of this course, students will be able to:

- Solve the solenoidal and irrotational vector and surface volume integral applications.
- Explain various physical models through higher order differential equations and solve such linear ordinary differential equations.
- Understand a variety of partial differential equations and solution by exact methods/method of

Separation of variables.

- Describe the applications of infinite series and obtain series solution of ordinary differential equations.
- Apply the knowledge of numerical methods in the models of various physical and engineering phenomena.

Textbooks:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

Reference books:

1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.

2. N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.
3. B.V.Ramana: “Higher Engineering Mathematics” 11th Edition, Tata McGraw-Hill, 2010.
4. Veerarajan T.,” Engineering Mathematics for First year”, Tata McGraw-Hill, 2008.
5. Thomas G.B. and Finney R.L.” Calculus and Analytical Geometry”9th Edition, Pearson, 2012.

QUESTION PAPER PATTERN:

- The question paper will have ten full questions carrying equal marks.
- Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Web links and Video Lectures (e-Resources):

- [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
- <http://academicearth.org/>

Semester	II	Course Title	Communicative English-II	Course Code	22AEC28
Teaching Period	50 Hours	L – T – P – TL	3 – 2 – 0 - 5	SEE	3 Hours
CIE	50 Marks	SEE	50Marks	Total	100 Marks
CREDITS - 01					

COURSE OBJECTIVES:

The course will enable the students,

- To Identify the Common Errors in Writing and Speaking of English.
- To Achieve better Technical writing and Presentation skills for employment.
- To read Technical proposals properly and make them to Write good technical reports.
- Acquire Employment and Workplace communication skills. To learn about Techniques of Information Transfer through presentation in different level.

COURSE CONTENTS:

: MODULE-1:(10Hours)

Identifying Common Errors in Writing and Speaking of English :

- Advanced English Grammar for Professionals with exercises, Common errors identification in parts of speech, Use of verbs and phrasal verbs, Auxiliary verbs and their forms, Subject Verb Agreement (Concord Rules with Exercises).
- Common errors in Subject-verb agreement, Noun-pronoun agreement, Sequence of Tenses and errors identification in Tenses. Advanced English Vocabulary and its types with exercises – Verbal Analogies, Words Confused/Misused.

: MODULE-2:(10Hours)

Nature and Style of sensible writing:

- Organizing Principles of Paragraphs in Documents, Writing Introduction and Conclusion, Importance of Proper Punctuation, The Art of Condensation (Precise writing) and Techniques in Essay writing, Common Errors due to Indianism in English Communication, Creating Coherence and Cohesion, Sentence arrangements exercises,

Practice of Sentence Corrections activities. Importance of Summarizing and Paraphrasing.

- Misplaced modifiers, Contractions, Collocations, Word Order, Errors due to the Confusion of words, Common errors in the use of Idioms and phrases, Gender, Singular & Plural. Redundancies & Clichés.

: MODULE-3:(10Hours)

Technical Reading and Writing Practices:

- Reading Process and Reading Strategies, Introduction to Technical writing process, Understanding of writing process, Effective Technical Reading and Writing Practices , Introduction to Technical Reports writing, Significance of Reports, Types of Reports.
- Introduction to Technical Proposals Writing, Types of Technical Proposals, Characteristics of Technical Proposals. Scientific Writing Process.
- Grammar – Voice and Speech (Active and Passive Voices) and Reported Speech, Spotting Error Exercises, Sentence Improvement Exercises, Cloze Test and Theme Detection Exercises.

: MODULE-4:(10Hours)

Professional Communication for Employment:

- The Listening Comprehension, Importance of Listening Comprehension, Types of Listening, Understanding and Interpreting, Listening Barriers, Improving Listening Skills. Attributes of a good and poor listener.
- Reading Skills and Reading Comprehension, Active and Passive Reading, Tips for effective reading.
- Preparing for Job Application, Components of a Formal Letter, Formats and Types of official, employment, Business Letters, Resume vs Bio Data, Profile, CV and others, Types of resume, Writing effective resume for employment, Model Letter of Application (Cover Letter) with Resume, Emails, Blog Writing, Memos (Types of Memos) and other recent communication types.

: MODULE-5:(10Hours)

Professional Communication at Workplace:

- Group Discussions – Importance, Characteristics, Strategies of a Group Discussions. Group Discussions is a Tool for Selection. Employment/ Job Interviews - Importance, Characteristics,
- Strategies of a Employment/ Job Interviews. Intra and Interpersonal Communication Skills -Importance, Characteristics, Strategies of a Intra and Interpersonal Communication Skills. Non-Verbal Communication Skills (Body Language) and its importance in GD and PI/JI/EI.

Presentation skills and Formal Presentations by Students - Importance, Characteristics, Strategies of Presentation Skills. Dialogues in Various Situations (Activity based Practical Sessions in class by Students).

Course Outcomes:

At the end of the course the student will be able :

1. To understand and identify the Common Errors in Writing and Speaking.
2. To Achieve better Technical writing and Presentation skills.
3. To read Technical proposals properly and make them to Write good technical reports.
4. Acquire Employment and Workplace communication skills.
5. To learn about Techniques of Information Transfer through presentation in different level.

QUESTION PAPER PATTERN:

Note: - The SEE question paper will be set for 100 marks and the marks scored by the student will be finally reduced to 50.

- The question paper will have fifty multiple choice questions carrying equalmarks.
- Each full question carries 1marks.
- Each full question will have sub question covering all the topics under amodule.
- The students will have to answer fifty full questions, selecting one full question from eachmodule.

Textbooks:

1. Communicative English II by Zestech Globla Pvt Ltd

Bachelor of Engineering - Electronics & Communication Engineering III SEMESTER

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination			Credits
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	22MAT31	Engineering Mathematics –III	Mathematics	2	1	0	3	3	50	50	100	3
2	22EC32	Analog Electronics Circuits	EC	2	1	0	3	3	50	50	100	3
3	22EC33	Digital system design using Verilog	EC	2	1	0	3	3	50	50	100	3
4	22EC34	Network Analysis	EC	3	1	0	4	4	50	50	100	4
5	22EC35	Signals and Systems	EC	3	1	0	4	4	50	50	100	4
6	22ECL36	Analog Electronics Circuits Lab	EC	0	0	2	2	3	50	50	100	1
7	22ECL37	Digital system design using Verilog Lab	EC	0	0	2	2	3	50	50	100	1
8	22AEC 38B	Soft Skill Development-I	HRD	2	0	0	2	2	50	50	100	1
9	22 UHV39B	Sports	Humanities	2	0	0	2	2	50	50	100	1
									450	450	900	21
CONTACT HOURS									32			
TOTAL CREDITS (I+II+III Sem)									20+20+21			

Audit Course All lateral entry students have to register for Additional Mathematics-I

1	22MATDIP31	Additional Mathematics-I	Mathematics	3	0	0	3	---	50	---	50	
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Bachelor of Engineering - Electronics & Communication Engineering IV SEMESTER

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination				Credits
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	22MAT41	Engineering Mathematics –IV	Mathematics	2	1	0	3	3	50	50	100	3	
2	22EC42	Microcontroller and its Applications	EC	2	1	0	3	3	50	50	100	3	
3	22EC43	Control Systems	EC	3	1	0	4	4	50	50	100	4	
4	22EC44	Digital Signal Processing	EC	3	1	0	4	4	50	50	100	4	
5	22EC45	Linear Integrated Circuits	EC	2	1	0	3	3	50	50	100	3	
6	22ECL46	MC Lab	EC	0	0	2	2	3	50	50	100	1	
7	22ECL47	DSP Lab	EC	0	0	2	2	3	50	50	100	1	
8	22AEC 48	Design, Thinking for Creativity & Innovation	HRD	2	0	0	2	2	50	50	100	1	
9	22.UHV49B	Yoga	Humanities	2	--	0	2	2	50	50	100	1	
									450	450	900	21	
CONTACT HOURS									32				
TOTAL CREDITS (I-II+III+IV Sem)									20+20+21+21				

Audit Course All lateral entry students have to register for Additional Mathematics-II

1	22MATDIP41	Additional Mathematics-II	Mathematics	3	0	0	3	---	50	---	50
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Semester	III	Course Title	Engineering Mathematics-III	Course Code	22MAT-31
Teaching Period	50 Hours	L – T – P – TL*	2 - 1 - 0 - 3	Credits	3 Hours
CIE*	50 Marks	SEE*	50Marks	Total	100 Marks
CREDITS – 3					

Course objectives:

- To have an insight into the Fourier series, Fourier transforms, Laplace transforms,
- To develop proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.
- To increase the creativity and confidence to do calculations in Arithmetic, Algebra and even Geometry for that matter and simplify and speed up calculations.

Module - 1

Laplace Transforms:

Definition and Laplace transform of elementary functions. Properties of Laplace transforms (without proof). Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Module – 2

Inverse Laplace Transforms: L1, L2

Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform (without proof) and problems, solution of linear differential equations using Laplace transforms.

Module – 3

Fourier series: L1, L2

Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period $2l$. Fourier series of even and odd functions. Half-range Fourier series. Practical harmonic analysis, examples from the engineering field.

Module – 4

Numerical Solutions of Ordinary Differential Equations (ODE's):

L1, L2 Numerical solution of ODE's of the first order and first degree-

Taylor's series method, Modified Euler's method. Runge - Kutta method of the fourth order, Milne's and Adam's- Bashforth predictor and corrector method (No derivations of formulae), Problems.

Module – 5

Vedic Mathematics: L1, L2, L3

Introduction to Vedic Mathematics, Multiplication of any number by number containing digit 1 only, Multiplication of any number by a number containing digit 9 only, Multiplication of any 4 digit numbers by any 4 digit numbers (Using Urdhvatiryagbhyam sutra). Finding the square root of perfect squares and cube roots of perfect cubes. Solution of Linear equations: Introduction, Solution of simple equations. Finding the Determinants of 4X4 matrix. Vedic Geometry- Area of Triangle (coordinates are given).

Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

L1-Understanding, L2-Remembering, L3-Applying.

Course outcomes: At the end of the course, the student will be able to:

- Use Laplace transform and Inverse Laplace transform in solving differential/ integral equations arising in network analysis, control systems and other fields of engineering.
- Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.
- Solve first and second-order ordinary differential equations arising in engineering problems by applying single-step and multistep numerical methods.
- Foster the love for mathematics by creating a positive attitude through Vedic and Ancient Indian Mathematics, the extremals of functionals using the calculus of variations and solve problems arising in the dynamics of Rigid bodies and vibration analysis.

Textbooks

- Advanced Engineering Mathematics, E. Kreyszing, John Wiley & Sons, 10th Edition, 2016.
- Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th Edition, 2017.

Reference Books:

- Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill, 11th Edition, 2010.
- A Text Book of Engineering Mathematics, N. P. Bali and Manish Goyal, LaxmiPublications, 2014.
- The essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, NewDelhi.

Semester	III	Course Title	Analog Electronics	Course Code	22EC32
Teaching Period	50 Hours	L – T – P – TL*	2 – 1 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 3					

Course objectives:

This course will enable students to:

- Understand various BJT parameters, BJT Amplifier, Hybrid Equivalent and Hybrid Models.
- Design and construct JFET, MOSFET and learn its characteristics.
- Identify various types of FET biasing, and demonstrate the use of FET amplifiers.
- Construct frequency response of BJT and FET amplifiers at various frequencies.
- Analyze Power amplifier circuits in different modes of operation.
- Construct Feedback and Oscillator circuits using FET.

Module – 1

BJT Biasing:

L1, L2, L3

Operating point, fixed bias circuits, voltage divider bias (exact analysis and approximate) With related equations and problems.

BJT AC Analysis: BJT Transistor Modeling, The re transistor model, Common emitter fixed bias, Voltage divider bias. The Hybrid equivalent model, Approximate Hybrid Equivalent Circuit- Fixed bias, Voltage divider, Hybrid π Model.

8 Hours

Module – 2

FET Frequency Response:

L1, L2, L3,

Logarithms, Decibels Low frequency response-FET Amplifier, Miller effect capacitance, High frequency response-FET Amplifier, Multistage Frequency Effects.

FET Amplifiers: JFET small signal model, Fixed bias configuration, Self bias configuration, Voltage divider configuration.

8 Hours

Module – 3

L1, L2, L3

MOSFETs: Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, and Drain to Gate feedback resistor. Small signal operation and modeling, The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, trans conductance.

MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance RS, Source follower. MOSFET internal capacitances and High frequency model: The gate capacitive effect, Junction capacitances, High frequency model. 8 Hours

Module – 4

L1, L2, L3

Feedback and Oscillator Circuits:

Feedback concepts, Feedback connection types, Oscillator operation, FET Phase shift oscillator, Wien bridge oscillator, Tuned Oscillator circuit, Crystal oscillator. 8 Hours

Module – 5

Power Amplifiers:

L1, L2, L3

Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Class C and Class D amplifiers. 8 Hours

Course Outcomes:

After studying this course, students will be able to:

- Design biasing circuits and calculate the AC gain and impedance for BJT using r_e and h parameters models for CB and CE configuration.
- Determine the parameters which effect the low frequency and high frequency of FET amplifier and performance characteristics FET amplifier using small signal model.
- Analyze MOS amplifier circuits for various configurations and frequency response.
- Describe the working principle and characteristics of feedback amplifiers and Phase shift, Wien bridge, tuned and, crystal oscillators using BJT/FET.
- Evaluate the efficiency of Class A and Class B power amplifiers.

Text Book:

- Robert L. Boylestad and Louis Nashelsky, —Electronics devices and Circuit theoryl, Pearson, 10th/11th Edition, 2012, ISBN:978-81-317-6459-6.
- Adel S. Sedra and Kenneth C. Smith, —Micro Electronic Circuits Theory and Applicationl, 5th Edition ISBN:0198062257.

Reference Books:

- Fundamentals of Microelectronics, Behzad Razavi, John Weily ISBN 2013 978-81- 265-2307-8
- J.Millman & C.C.Halkias—Integrated Electronics, 2nd edition, 2010, TMH. ISBN 0- 07-462245-5
- K. A. Navas, —Electronics Lab Manuall, Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424.

Semester	III	Course Title	Digital System Design using Verilog	Course Code	22EC33
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 3	Credits	3
CIE*	50	SEE*	50	Total	100
CREDITS - 3					

Course Objectives: This Course will Enable Students to

1. Impart the concepts of simplifying Boolean expression using K-map techniques and Quine McCluskey minimization techniques.
2. Analyze the concepts of combinational logic circuits and sequential logic circuits
3. Modelling the Digital circuits using Verilog design styles.

MODULE – 1

Principles of Combinational Logic:

L1,L2,L3

Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't Care Terms. (Section 3.1 to 3.5 of Text 1).

08hrs

MODULE – 2

Logic Design with MSI Components and Programmable Logic Devices:

L1,L2,L3 Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs) (Section 5.1 to 5.7 of Text 2)

08hrs

MODULE – 3

Flip-Flops and its Applications:

L1,L2,L3

The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. (Section 6.4,6.6 to 6.9(Excluding 6.9.3) of Text2)

08hrs

MODULE – 4

Introduction to Verilog:

L1,L2,L3

Introduction to Verilog HDL, Structure of Verilog module, Operators, Data Types, Styles of Description. (Section 1.2 to 1.6 (only Verilog) of Text 3)
Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description, Data type-vectors(2x2 Unsigned Combinational Array Multiplier)(Section 2.1 to 2.3 (only Verilog) of Text 3) 08hrs

MODULE – 5

Verilog Behavioral description:

L,L2,L3

Behavioral description Highlights of Behavioral Description, Structure, Sequential Statements-if, else-if, case statement, Loop Statements, Verilog Behavioral Description of Booth algorithm (Section 3.1, 3.2,3.4 (only Verilog) of Text 3)

Verilog Structural description: Highlights of Structural description, Organization of structural description, Structural description of SRAM cell. (Section 4.1 to 4.2 of Text 3) 08hrs

Course Outcomes: At the end of the course the student will be able to:

1. Discuss the Simplification of given Boolean functions using K-map and Quine-McCluskey minimization technique.
2. Explain the concepts of Combinational and sequential circuits.
3. Analyze the Structural and Behavioral concepts of Digital circuits using Verilog.
4. Design the Various types of Combinational, Sequential logic circuits and also various styles of Verilog description for the given application.

Text Book:

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001.
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Logic Design, by Sudhakar Samuel, Pearson/ Sanguine, 2007
3. Verilog HDL by Samir Palnitkar, Second Edition, pearson education
4. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010

Semester	III	Course Title	Signals and Systems	Course Code	22 EC 34
Teaching Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 4	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 4					

Course objectives: This course will enable students to:

- Understand the mathematical description of continuous and discrete time signals and systems.
- Analyze the signals in time domain using convolution sum & integral.
- Classify the signals into different categories based on their properties.
- Analyze Linear Time Invariant (LTI) systems in time and transform domains. Build basics for understanding of courses such as signal processing, control system and communication.

Module -1

L1, L2,L3

Introduction and Classification of signals: Definition of signals and systems, communication and control system as examples, Classification of signals.

Basic Operations on signals:

Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and time reversal.

Elementary signals/Functions:

Exponential, sinusoidal, step, impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals.

10 Hours

Module -2

System Classification: L1, L2, L3,L4

Linear-nonlinear, Time variant-invariant, causal-non causal, static-dynamic, stable-unstable, invertible.

Time domain representation of LTI System:

Impulse response, convolution sum, convolution integral. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular.

10 Hours

Module -3

LTI system properties in terms of impulse response: L1, L2, L3

System interconnection, Memory less, Causal, Stable, and step response in terms of impulse response.

Fourier Representation of Periodic Signals: CTFS properties and basic problems. 10 Hours

Module -4

Fourier Representation of aperiodic Signals: L1, L2, L3

Introduction to Fourier Transform & DTFT, Definition and basic problems.

Properties of Fourier Transform:

Linearity, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform. 10 Hours

Module -5

The Z-Transforms: L1, L2, L3

Z transform, properties of region of convergence, properties of Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems. 10 Hours

Course Outcomes: At the end of the course, students will be able to:

- Acquire basic knowledge of Continuous time & discrete time signals, Classifications of signals & systems.
- Analyse the time domain representations of LTI systems using Convolution.
- Apply the concepts of Frequency domain representation of signals & its advantages.
- Apply the properties of Fourier representations of signals.
- Demonstrate the conversion of time domain signals to Z-domain.

Text Book:

- Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.

Reference Books:

- Michael Roberts, “Fundamentals of Signals & Systems”, 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
- Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, “Signals and Systems” Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.
- H.P Hsu, R. Ranjan, “Signals and Systems”, Scham’s outlines, TMH, 2006.
- B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2005.
- Ganesh Rao and SatishTunga, “Signals and Systems”, Pearson/Sanguine.

Semester	III	Course Title	Network Analysis	Course Code	22 EC 35
Teaching Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 4	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 4					

Course objectives: This course enables students to:

- Describe basic network concepts emphasizing source transformation, source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.
- Explain network Thevenin,,s, Millman,,s, Superposition, Maximum Power transfer and Norton,,s Theorems,,s and apply them in solving the problems related to Electrical Circuits.
- Explain the behavior of networks subjected to transient conditions. Use applications of Laplace transforms to network problems.
- Describe Series and Parallel Combination of Passive Components as resonating circuits, related parameters and to analyze frequency response.
- Study two port network parameters like Z, Y, T and h and their inter-relationships and applications.

Module -1

Basic Concepts:

L1, L2,L3,L4

Ideal & Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Super mesh and Super node Analysis.

10 Hours

Module -2

Network Theorems:

L1, L2, L3,L4

Millman’s theorem, Superposition theorem, Thevenin’s and Norton’s theorem, Maximum Power transfer theorem.

10 Hours

Module -3

Transient behavior and initial conditions:

L1, L2, L3,L4

Behavior of circuit elements under switching condition and their

Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.

Laplace Transformation & Applications: Solution of networks, step, ramp and impulse responses. 10 Hours

Module -4

Resonant Circuits: L1, L2, L3,L4

Series and parallel resonance, frequency- response of series and Parallel circuits, Q-Factor, Bandwidth.

Network Synthesis: Hurwitz polynomials, positive real functions, Elementary Synthesis of networks. 10 Hours

Module -5

Two port network parameters: L1, L2, L3, L4

Definition of Z, Y, h and Transmission parameters, modeling with these parameters, relationship between parameters sets. 10 hours

Course Outcomes: After studying this course, students will be able to:

- Apply the knowledge to solve the networks using mesh and nodal analysis.
- Analyze the networks using transformation techniques, network theorems, Laplace transformations and various types of resonating circuits.
- Apply the initial conditions for the networks and analyze their behaviors.
- Apply and Analyze the two port networks.

Text Books:

- M.E.VanValkenberg (2000), Network analysis, Prentice Hall of India, 3rd edition, 2000, ISBN: 9780136110958.
- Roy Choudhury, Networks and systems, 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677.
- Ravish R. Singh, "Network Analysis and Synthesis", McGraw Hill Education, 2017, ISBN: 1259062957.

Reference Books:

- Hayt, Kemmerly and Durbin—Engineering Circuit Analysis, TMH 7th Edition, 2010.
- J. David Irwin /R. Mark Nelms,—Basic Engineering Circuit Analysis, John Wiley, 8th edition, 2006.
- Charles K Alexander and Mathew N O Sadiku, — Fundamentals of Electric Circuits, Tata McGraw-Hill, 3rd Edition, 2009.

Semester	III	Course Title	Analog Electronics Lab	Course Code	22 ECL 36
Teaching Period	50 Hours	L – T – P – TL*	0 – 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 2					

Course Objectives: This laboratory course enables students to get practical experience in design, assembly, testing and evaluation of:

- Rectifiers and Voltage Regulators.
- BJT characteristics and Amplifiers.
- JFET Characteristics and Amplifiers.
- MOSFET Characteristics and Amplifiers
- Power Amplifiers.
- RC-Phase shift, Hartley, Colpitts and Crystal Oscillators.

LIST OF EXPERIMENTS:

1. Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency: (a) Full Wave Rectifier (b) Bridge Rectifier.
2. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
3. Conduct an experiment on Series Voltage Regulator using Zener diode and power transistor to determine line and load regulation characteristics.
4. Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances.
5. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain- bandwidth product from its frequency response.
6. Plot the transfer and drain characteristics of a JFET and calculate its drain resistance, mutual conductance and amplification factor.
7. Design, setup and plot the frequency response of Common Source JFET/ MOSFET amplifier and obtain the bandwidth.
8. Plot the transfer and drain characteristics of n-channel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.

9. Set-up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency.
10. Design and set-up the RC-Phase shift Oscillator using FET, and calculate the frequency of output waveform.
11. Design and set-up the following tuned oscillator circuits using BJT, and determine the frequency of oscillation. (a) Hartley Oscillator (b) Colpitts Oscillator.
12. Design and set-up the crystal oscillator and determine the frequency of oscillation.

DEMONSTRATION EXPERIMENTS (FOR CIE ONLY):

1. Water Level Indicator Using Simple Transistors.
2. Light Detector using LDR and Transistors.

COURSE OUTCOMES: On the completion of this laboratory course, the students will be able to:

- Apply the working principle of diode to design rectifiers, clipping circuits, clamping circuits and voltage regulators.
- Compute the parameters from the characteristics of JFET and MOSFET devices.
- Design and verify BJT amplifiers in CE configuration.
- Design and verify JFET/MOSFET Amplifiers and Power Amplifier.
- Design and verify various types of oscillators.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

Semester	III	Course Title	Digital System Design using Verilog Lab	Course Code	22 ECL 37
Teaching Period	24 Hours	L – T – P – TL*	0 – 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 2					

COURSE OBJECTIVES:

This laboratory course enables students to get practical experience in design, assembly, testing, evaluation, Realization and Verification of:

- Impart the concepts of De Morgan’s Theorem, SOP, POS forms.
- Impart the concepts of designing and analyzing combinational logic circuits and sequential logic circuits.
- Realize the program to simulate and synthesize the digital design.
- Synthesize Combinational and Sequential logic circuits on FPGAs / CPLD.
- Interface the external hardware to the FPGAs/CPLDs and obtain the desired output.

Laboratory Experiments:

1. Verify
 - a. Demorgan’s Theorem for 2 variables.
 - b. The sum-of product and product-of-sum expressions using universal gates.
2. Realize
 - a. Adder & Subtractor using IC74153.
 - b. 4-variable function using IC74151 (8:1MUX).
 - c. Realize a Boolean expression using decoder IC74139
3. Realize Master-Slave JK, SR ,D & T Flip-Flops using NAND Gates
4. Realize the following shift registers using IC7474/IC7495 SISO (b) SIPO (c) PISO (d) PIPO (e) Ring and (f) Johnson counter.
5. Simulate Full- Adder using simulation tool.
6. Simulate a Mod-8 Synchronous UP/DOWN Counter using simulation tool
7. Write Verilog code to realize all the logic gates

8. Write the Verilog program for the following combinational design . with test bench
 - a. 8 to 3 encoder with priority and without priority using behavioral model.
 - b. 8 to 1 multiplexer using case statement and if statements using behavioral model
 - c. 4 bit comparator using behavioral model
9. Write Verilog code for SR, D ,T and JK and verify the flip flop
10. Design a 4-bit Synchronous Up Counter
11. Write the HDL interfacing code to control speed, direction of DC motor and Stepper motor
12. Write HDL code to generate - Sine, Square, Triangle and Ramp waveforms using DAC with different frequency

COURSE OUTCOMES: The students are able to demonstrate

CO1: Discuss, model and test the combinational logic circuit for the given specification.

CO2: Implement, model and test the sequential logic circuit for the given specification.

CO3: Demonstrate digital logic circuit using simulation tool

CO4: Develop a behavioral code to control stepper motor and generation of Sine, Square, Triangle and Ramp wave form

Semester	III	Course Title	Soft Skill Development I	Course Code	22AEC38A/38B
Teaching-Period	25 Hours	L – T – P – TL*	2 – 0 – 0 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 4					

Course objectives: The course will enable the students,

- To Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
- To provide students with a strong conceptual and practical framework to build, develop and manage teams.
- To help formulate problem solving skills

Module -1 (5Hours)

Quantitative Aptitude (Level-1)

Blood Relation, Direction Sense, Decision making & logical Sequencing, Group of Identical Figures, Verification of Truth of Statement.

Module -2 (5Hours)

Verbal (Level-1)

Adjective and prepositions, Adverbs, Abstract nouns & collective nouns, Error spotting & sentence framing. Personal effectiveness, Idioms, phrases & Vocabulary

Module -3 (5Hours)

Quantitative Aptitude (Level-2)

Odd man out, HCF & LCM, Vedic Mathematics, Coding and Decoding, Image Analysis, Mathematical operators, Dot situation, Letter and symbol series, Data sufficiency, Machine input and output.

Module -4 (5Hours)

Verbal (Level-2)

Verbal analogies, One word substitute, Subject verb agreement, Idioms & phrases, Essay.

Module -5 (5Hours)

Quantitative Aptitude (Level-3)

Percentage, Profit & Loss, Averages, Heights & Distances, Syllogisms, Time Speed and Distance.

Text Books:

1. Communicative English by Zestech Globla Pvt Ltd
2. Arun Sharma - Quantitative Aptitude
3. Arihant Publications - Fast Track Objective Arithmetic

QUESTION PAPER PATTERN:

Note:-SEE for AEC and UHV courses for 2022 scheme and SSD courses will be conducted in Batch wise.

- The question paper will have fifty multiple choice questions carrying equal marks.
- Each full question carries 1marks.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer fifty full questions, selecting one full question from each module.

Semester	III	Course Title	Sports	Course Code	22AEC39A/39B
Teaching-Period	25 Hours	L – T – P – TL*	2 – 0 – 0 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 4					

Course objectives: The course will enable the students,

- Develop physical talents to their maximum potential.
- Engage in competitive activities, while promoting sound health, safety, and physical fitness.
- Exemplify good conduct as a means for learning good citizenship.
- Learn to appropriately experience both success and failure in an educational environment.

Module -1 (5Hours)

Volley ball

Player stance, Receiving and passing, The Volley (Overhead pass), The Dig (Underhand pass), Service Reception, Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service. High spin service, Asian serve American serve (floating), Setting the ball- Set for attack, Back set, Jump set Smash Spike- Straight smash, Body turns smash. Wrist outward smash. Wrist inward smash.

Module -2 (5Hours)

Basketball

Grip: Player stance- Triple threat stance and Ball handling exercises Passing (Two hand/one hand)- Chest pass, Bounce Pass, Overhead pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.

Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving While jumping, Receiving while running,
Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations Shooting-Layup shot and its variations, one hand set shot, one hand jump shot, Free throw, Hook shot, Tip-in shot.

Module -3 (5Hours)

Cricket Batting-Forward (front foot) and backward (back foot) defensive stroke, Drives Bowling- Simple bowling techniques, Fast bowling, Spin bowling Fielding-Orthodox fielding and Long Barrier (defensive). Pick up and throw and Chase and Return/Throwing techniques (offensive) Catching- High catch and Low catch Wicket keeping techniques- Stance. Position, Collection of Ball, Ground measurements, Rule and their interpretations and Duties of officials.

Kabaddi

Raiding Skills: -Can't, Entry, Footwork, Attack, Retreat; Hand touches; Leg touches: -Toe touch, Foot touch, Squat leg thrust: Various kicks: - Back kick, Side kick, Running kick, Curve kick. Crossing of baulk line, Crossing of Bonus line, Learning the opponent to catch, Pursuing. Additional skills in raiding: - Bringing the antis in to particular position, Escaping from various holds, Techniques of escaping from chain formation.

- Defensive Skills: - Holding Skills: Wrist hold. Ankle hold, Dive and Ankle Hold, Knee hold, thigh hold, Waist hold, Blocking- Chest block; Chain Hold.

Module -5 (5Hours)

Kho-Kho:

Sitting in the square- Parallel toe / Shuffling or bullet toe method Giving "Kho":- Proximal and Distal foot Advance Kho, Giving Kho' with a fake. General skills of the game- Running, Chasing, Dodging, Faking etc.

Skills in chasing- Moving on the cross lane, Pursuing the runner, Direct, Indirect and Surprise attack Tapping- Heel, Shoulder and on the pole, Diving, Judgment Kho, Rectification of Foel, Skills in Running Single and double chain, Variations in ring games, dodging while facing on the back, Pole turning, Pole diving, Pole Avoiding, Attack after pole turning, Fakes- Body, Arm, Legs etc., Counter action for ring game Combination of different skills Court marking, Rules and their interpretations and Duties of officials.

Text Books:

- The Volleyball Handbook" by Bob Miller.
- The Book of Basketball by Bill Simmon
- Bat, Ball and Field: The Elements of Cricket: A Guide to the History, Miscellany and Magic of the Sport of Cricket by jon hotten.

- A Text Book on Kabaddiby Muniraju
- A Text Book of Kho-Kho Dr Kavita Verma

QUESTION PAPER PATTERN:

Note:-SEE for AEC and UHV courses for 2022 scheme and SSD courses will be conducted in Batch wise.

- The question paper will have fifty multiple choice questions carrying equal marks.
- Each full question carries 1marks.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer fifty full questions, selecting one full question from each module.

Semester	III	Course Title	ADDITIONAL MATHEMATICS –I	Course Code	22MATDIP31
Teaching- Period	25 Hours	L – T – P – TL*	3– 0 – 0 – 3	Credits	--
CIE*	50 Marks	SEE*	---	Total	50 Marks
CREDITS – 4					

Course objectives: The course will enable the students,

- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE's.

Module -1 (5Hours)

Complex Trigonometry:

Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).

Vector Algebra:

Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

Module -2 (5Hours)

Differential Calculus:

Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.

Module -3 (5Hours)

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.

Module -4 (5Hours)

Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin nx$, $\cos nx$ (with proof) and $\sin mx$, $\cos nx$ (without proof) and evaluation of these with standard limits- Examples. Double and triple integrals-Simple examples.

Module -5 (5Hours)

Ordinary differential equations(ODE's):

Introduction-solutions of first order and first degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.

Course outcomes:

At the end of the course the student will be able to:

- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.
- CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

Textbook:

- Higher Engineering Mathematics, B.S.Grewal, Khanna Publishers, 43rd Edition, 2015

Reference Books:

- Advanced Engineering Mathematics, E.Kreyszig, John Wiley & Sons, 10th Edition, 2015
- Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publishers, 7th Edition, 2007
- Engineering Mathematics Vol.I, Rohit Khurana, Cengage Learning, 1st Edition, 2015

Semester	IV	Course Title	Engineering Mathematics-IV	Course Code	22MAT-41
Teaching Period	50 Hours	L – T – P – TL*	2 - 1 - 0 - 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100
CREDITS - 3					

Course objectives:

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

MODULE – 1

Calculus of complex functions:

L1, L2

Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions:

Cauchy-Riemann equations in Cartesian and polar forms and consequences.

Construction of analytic functions (Milne Thomson method problems).

MODULE – 2

Numerical solution of algebraic and transcendental equation: L1, L2, L3 Bisection method.

Numerical solution of second order ODE's: Runge-Kutta method of 4th order and Milne's Predictor and Corrector method, Picard's method (only formulae) – Simple problems.

MODULE – 3

Statistical Methods:

L1, L2, L3

Correlation and regression-Karl Pearson's coefficient of correlation – problems. Regression analysis- lines of regression – problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.

MODULE – 4

Probability Distributions:

L1, L3

Basic concepts of probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions, problems.

MODULE – 5

Joint probability distribution:

L2, L3, L4

Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.

Sampling Theory: Stochastic process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability – simple problems.

Course outcomes:

At the end of the course the student will be able to:

- Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- Solve first and second order ordinary differential equations arising in engineering problems by applying single step and multistep numerical methods.
- Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering applications and Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Textbooks

1. Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, 10th Edition, 2016.
2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th Edition, 2017.

Reference Books

1. Higher Engineering Mathematics, B.V.Ramana, McGraw Hill, 11th Edition, 2010.
2. A Text Book of Engineering Mathematics, N.P.Bali and Manish Goyal, Laxmi Publications, 2014.

Semester	IV	Course Title	Microcontroller and Its Applications	Course Code	22 EC 42
Teaching Period	40Hours	L – T – P – TL*	2 – 1 – 0 - 3	Credits	03
CIE*	50	SEE*	50	Total	100
CREDITS - 3					

Course Objectives:

This course will enable students to:

- Familiarize the difference between a Microprocessor and a Microcontroller, basic architecture and Memory Interfacing of 8051.
- Program 8051 microcontroller using Assembly Level Language.
- Understand the Stack and interrupt of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial communication of 8051.
- Applications of 8051 through Interfacing.

MODULE – 1

Module-1

L1, L2, L3

8051 Microcontroller: Microprocessor Vs Microcontroller, Von-Neumann & Harvard CPU architecture, CISC and RISC CPU architecture, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Assembler Directives, Internal Memory organization. External Memory (ROM & RAM) interfacing. 08 Hours

MODULE – 2

Module -2

L1, L2, L3,L4

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions, Subroutine instructions, Simple Assembly language program examples to use these instructions. 08 Hours

MODULE – 3

Module-3

L1, L2, L3

8051 Stack and Interrupts: Stack Operation, Basics of Interrupt, Interrupt Vector Table, Level Triggered Interrupt, and Edge Triggered Interrupt, Interrupt Priority.

8051 Timers:**L1, L2, L3,L4**

Basics of Timers, Operation and Programming of Timers in Mode 0 and 1, Time Delay Generation, Simple Assembly Language programming of 8051 timers Delay calculations. 08 Hours

MODULE – 4**Module -4****L1, L2, L3,L4**

8051 Serial Communication: 8051 Serial Communication: Basics of Serial Data Communication, Parallel Communication, Serial data Transmission formats, Serial data Transmission Classification, Serial Control Register, Power Mode Control Register, Simple Serial communication Programming to transmit a message and to receive data serially in assembly and C.

8255A Programmable Peripheral Interface: Block Diagram of 8255A, I/O addressing, Control Word Format of 8255. 08 Hours

MODULE – 5**Module 5****L1, L2, L3**

Applications of 8051 Microcontroller: Interfacing 8051 to ADC, DAC, Traffic light controller and Stepper motor and their interfacing programming. 08 Hours

Course Outcomes: At the end of the course, students will be able to:

- Implement Outline External memory Interfacing to 8051 and to study the History, evaluation of Microprocessors Vs Microcontroller, Architecture, Registers, I/O Ports, Assembler Directives.
- Analyze addressing modes and 8051 Assembly level programs using the 8051 instruction set.
- Classify stacks, interrupts, timers, counters and their I/O port interface programming using assembly languages.
- Categorizing serial communication, 8255 Programmable peripherals Interface operations, and Serial Communication programming using assembly and C language.
- Execute the 8051 to ADC, DAC, Traffic light controller and Stepper motor.

Text Book:

1. “The 8051 Microcontroller and Embedded Systems using assembly and C”, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
2. “The 8051 Microcontroller”, Kenneth J. Ayala, 3rd Edition, Thomson/ Cengage Learning.

Reference Books:

1. “The 8051 Microcontroller Based Embedded Systems”, Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
1. “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Raj Kamal, Pearson Education, 2012.
2. The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B. Brey, 6e, Pearson Education / PHI, 2003.
3. “Microcontroller Theory and Application”, Ajay V.Deshmukh, McGraw Hill, New Delhi, 2011, ISBN:9780070585959.
4. “Microcontroller Principle and Application”, Ajitpal, PHI Learning, New Delhi, 2014, ISBN: 978- 81-203-4392-4

Semester	IV	Course Title	Control Systems	Course Code	22 EC 43
Teaching-Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 4	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 4					

Course objectives: This course will enable students to:

- Understand the basic features, configurations and application of control systems. Understand various terminologies and definitions for the control systems.
- Learn how to find a mathematical model of electrical, mechanical and electro- mechanical systems.
- Know how to find time response from the transfer function. Find the transfer function via Mason's rule.
- Analyze the stability of a system from the transfer function.

Module -1

Introduction to Control Systems:

L1, L2, L3

Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Electromechanical systems, Analogous Systems. 10 Hours

Module -2

Block diagrams and signal flow graphs:

L1, L2, L3

Transfer functions, Block diagram algebra and Signal Flow graphs. 10 Hours

Module -3

Time Response of feedback control systems:

L1, L2, L3, L4

Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design). 10 Hours

Module -4

Stability analysis:

L1, L2, L3, L4

Concepts of stability, Necessary conditions for Stability, Routh stability

criterion, Relative stability analysis: more on the Routh stability criterion. Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci. 10 Hours

Module -5

Frequency domain analysis:

L1, L2, L3, L4

Introduction, Bode plots, Introduction to polar plots, (Inverse polar plots excluded), Mathematical preliminaries, Nyquist stability criterion, (Systems with transportation lag excluded), Introduction to lead, lag and lead-lag compensating networks(excluding design).

Introduction to state variable analysis: Concept of state, state variable and state models for electrical system, Solution of state equations. 10 Hours

Course Outcomes: At the end of the course, the students will be able to

- Determine the mathematical model of mechanical and electrical systems.
- Solve the transfer function for a given system using block diagram reduction techniques and signal flow graph method.
- Calculate the time domain specification for first and second order systems and understand the working of PID Controller.
- Estimate the stability of a system in the frequency domain using Nyquist, Polar Plots and bode plots, Routh-Hurwitz criterion and Root-locus technique.
- Analyze the behaviour of systems using state variable and state models.

Text Book:

- J. Nagarath and M. Gopal, — Control Systems Engineering, New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-7.

Reference Books:

- Modern Control Engineering, K. Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
- Automatic Control Systems, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
- Feedback and Control System, Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

Semester	IV	Course Title	Digital Signal Processing	Course Code	22 EC 44
Teaching-Period	50 Hours	L – T – P – TL*	2 – 1 – 0 - 3	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 4					

Course objectives: This course will enable students to:

- To prepare students with fundamental knowledge/ overview in the field of Digital Signal Processing
- To equip students with a basic foundation of Signal Processing by delivering the basics of Discrete Fourier Transforms & their properties, design of filters and overview of digital signal processors

Module -1

Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of Discrete Time Signals, DFT as a linear transformation, its relationship with other transforms.

Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution.

L1, L2, L3 [Text 1]

10 Hours

Module -2

Linear filtering methods based on the DFT: Filtering of long data sequences: overlap-add and overlap-save method.

Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms), Radix-2 FFT algorithms for the computation of DFT and IDFT decimation in-time & decimation in-frequency. **L1, L2, L3 [Text 1]**

10 Hours

Module -3

Design of FIR Filters: Characteristics of practical frequency-selective filters, Symmetric and Anti-symmetric FIR filters, Design of Linear-phase FIR (lowpass) filter using windows - Rectangular, Hamming, Hanning, Bartlett windows.

Structure for FIR Systems: Direct form, Cascade form and Lattice structures.

L1, L2, L3 [Text 1]

10 Hours

Module -4

IIR Filter Design:

Realization of IIR Filters: Direct form I and II.

IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, design of analog Filters using Butterworth and Chebyshev filters, design of digital Filters using Butterworth and Chebyshev filters using Bilinear transformation (low pass).

L1, L2, L3 [Text 2]

10Hours

Module -5

Digital Signal Processors:

DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, FIR and IIR filter implementations in Fixed point systems.

L1, L2, L3 [Text 2]

10 Hours

Course Outcomes: At the end of the course the student will be able to:

- Determine the response of LTI systems using time domain and DFT techniques
- Compute DFT of real and complex discrete time signals
- Compute DFT using FFT algorithms
- Design FIR and IIR Filters
- Design of Digital Filters using DSP processor

Text Books:

- Proakis & Manolakis, “Digital Signal Processing - Principles Algorithms & Applications”, 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
- Li Tan, Jean Jiang, “Digital Signal processing - Fundamentals and Applications”, Academic Press, 2013, ISBN: 978-0-12-415893.

Reference Books:

- Sanjit K Mitra, “Digital Signal Processing, A Computer Based Approach”, 4th Edition, McGraw Hill Education, 2013.
- Oppenheim & Schaffer, “Discrete Time Signal Processing”, PHI, 2003.
- D Ganesh Rao and Vineeth P Gejji, “Digital Signal Processing” Cengage India Private Limited, 2017, ISBN: 9386858231

Semester	IV	Course Title	Linear Integrated Circuits	Course Code	22EC45
Teaching Period	50Hours	L – T – P–TL*	2 – 1 – 0 - 3	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS–3					

Course objectives: This course will enable students to:

- Define and describe various parameters of Op Amp, its characteristics and specifications.
- Discuss the effects of Input and Output voltage ranges upon Op-Amp circuits. Sketch and Analyze Op-Amp circuits to determine Input Impedances, output Impedances and other performance parameters.
- Sketch and Explain typical Frequency Response graphs for each of the Filter circuits showing Butter worth and Chebyshev responses where ever appropriate.
- Describe and Sketch the various switching circuits of Op-Amps and analyze its operations.
- Differentiate between various types of DACs and ADCs and evaluate the performance of each with neat circuit diagrams and assuming suitable inputs.

Module–1

Operational Amplifier Fundamentals:

L1, L2,L3

Basic Op-amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations.

OP-Amps as DC Amplifiers – Biasing OP-amps, Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers, Summing amplifiers, and Difference amplifiers. Interpretation of OP-amp LM741&TL081 datasheet.

10 hours

Module–2

Op-Amps as AC Amplifiers:

L1, L2,L3

Capacitor coupled voltage follower, High input impedance–Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, High input impedance – Capacitor coupled Non inverting amplifiers, Capacitor

coupled inverting amplifiers, setting the upper cut-off frequency, Capacitor coupled difference amplifier.

OP-Amp Applications: Voltage sources, current sources and current sinks, current amplifiers, Instrumentation amplifier, precision rectifiers.(Text1)

10 hours

Module–3

More Applications:

L1, L2,L3

Limiting circuits, Clamping circuits, Peak detectors, Sample and hold circuits, V to I and I to V converters, Differentiating Circuit, Integrator Circuit, Phase shift oscillator, Wien bridge oscillator, Crossing detectors, inverting Schmitt trigger. Log and antilog amplifiers, Multiplier and divider. 10 hours

Module–4

Active Filters:

L1, L2,L3

First order and second order active Low-pass and high pass filters, Band pass Filter, Band stop Filter. Voltage Regulators: Introduction, Series Op-amp regulator, IC voltage regulators. 723 general purpose regulators. 10 hours

Module–5

Phase locked loop(PLC):

L1, L2,L3

Basic Principles, Phase detector/comparator, VCO. DAC and ADC convertor: DAC using R-2R, ADC using Successive approximation. Other IC Applications 555 timer, Basic timer circuit, 555 timer used as Astable and Monostable multivibrator. 10 hours

Course Outcomes: After studying this course, students will be able to:

- Explain all the op-amp parameters and its circuits.
- Apply Op- Amps to construct the voltage /current sources and sinks, current, instrumentation, precision amplifiers and AC amplifiers.
- Discuss the linear and Non linear applications of Op-Amp.
- Design Op-Amp active filters and voltage regulators using 723 IC.
- Analyze the Monostable, Astable circuits using 555 Timer IC and Principles of PLL.

Text Books:

- David A. Bell, 2nd edition, PHI /Pearson,2004.ISBN978-81-203-2359-9.
- D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2006, New Age International ISBN 978- 81-224-3098-1.

Reference Books:

- Ramakant A Gayakwad,—Op Amps and Linear Integrated Circuits, Pearson, 4thEd,2015.ISBN81-7808-501-1.
- B Somanathan Nair, —Linear Integrated Circuits: Analysis, Design &Applications, Wiley India, 1st Edition, 2015.
- James Cox,—Linear Electronics Circuits and Devices Cengage Learning, Indian Edition,2008,ISBN-13:978-07-668-3018-7.
- Data Sheet: <http://www.ti.com/lit/ds/symlink/tl081.pdf>.

Semester	IV	Course Title	Digital Signal processing Lab	Course Code	22 ECL 46
Teaching-Period	24 Hours	L – T – P – TL*	0 – 0 – 2 - 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 2					

Course Objectives: This course will enable students to

- Simulate discrete time signals and verification of sampling theorem.
- Compute the DFT for a discrete signal and verification of its properties using MATLAB.
- Compute and display the filtering operations and compare with the theoretical Values.
- Implement the DSP computations on DSP hardware and verify the result.

Laboratory Experiments

Following Experiments to be done using MATLAB / SCILAB / OCTAVE or Equivalent:

1. Verification of sampling theorem.
2. Computation of linear & circular convolution of the two given sequences and verification of commutative, distributive and associative properties of convolution.
3. Computation of linear and circular convolution of the two sequences using DFT and IDFT.
4. Computation of N-point DFT of a given sequence and to plot magnitude and phase spectrum using built-in routine.
5. Verification of Linearity&Parseval’s theorem of DFT.
6. Verification of circular time shifting & circular frequency shifting properties of DFT.
7. Design and implementation of IIR (Butterworth) filters to meet the given specifications.
8. Design and implementation of FIR filters using different window techniques.

Following Experiments to be done using DSP Kit:

9. To compute N- Point DFT of a given sequence using DSK 6713 simulator

10. To compute linear convolution of two given sequences using DSK 6713 simulator
11. To compute circular convolution of two given sequences using DSK 6713
12. To perform impulse response of first order and second order system.

Course Outcomes:

1. Apply the fundamental DSP concepts of MATLAB to solve DSP problems.
2. Analyze the concepts of Sampling theorem, linear convolution, circular convolution and properties of DFT.
3. Design IIR and FIR filters for the given specifications.
4. Provide the basic knowledge of trainer kit TMS320C6713 DSP Processors.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
3. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

Semester	IV	Course Title	Microcontroller and Its Applications Lab	Course Code	22 ECL 47
Teaching Period	24 Hours	L – T – P – TL*	0 – 0 – 2 - 2	Credits	02
CIE*	50	SEE*	50	Total	100
CREDITS -2					

Course Objectives: This laboratory course enables students to

- Understand the basics of microcontroller and its applications.
- Have in-depth knowledge of 8051 assembly language and C programming.
- Understand controlling the devices using programming Languages.
- The concepts of I/O interfacing for developing real time embedded systems.

LIST OF EXPERIMENTS:

I. Programming

1. Data Transfer: Block Move, Exchange, Sorting, Finding largest element in an array.
2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable).
3. Counters.
4. Boolean & Logical Instructions (Bit manipulations).
5. Conditional CALL & RETURN.
6. Code conversion: BCD-ASCII; ASCII-Decimal; Decimal-ASCII; HEX-Decimal and Decimal- HEX.

II. Interfacing

1. Write a C program to rotate Stepper motor control interface to 8051.
2. Write a C program to rotate DC motor control interface to 8051.
3. Write a C program to interface an LCD display and to display a message on it.
4. Write a C program to interface Counter Program.
5. Generate different waveforms using DAC interface to 8051.

DEMONSTRATION EXPERIMENTS (FOR CIE ONLY):

Course Outcomes: On the completion of this laboratory course, the students will be able to:

1. Analyze 8051 C programs to perform data transfer, arithmetic, Boolean and logical operations.
2. Analyze 8051 C programs to perform counter operation along with conditional call and return operation.
3. Analyze 8051 C programs to perform code conversion operation like BCD, ASCII, decimal and Hex operation.
4. Demonstrate the interfacing of 8051 Programs with Stepper Motor, DC Motor, LCD Display and Counters.
5. Demonstrate the interfacing of 8051 Programs to generate different waveform using DAC.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for
- Break up of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure

Semester	IV	Course Title	Design Thinking for creativity & Innovation	Course Code	22EC48A/48B
Teaching Period	25Hours	L – T – P–TL*	2 – 0 – 0 - 2	Credits	1
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS–3					

Course objectives: The course will enable the students,

- To Explain the fundamental concept of Innovation and Design Thinking.
- To Demonstrate how to observe and convert observation data to insights.
- To Apply design thinking concept in functional work.

Module–1

Introduction to Design Thinking: Importance of Design Thinking–Phases in design thinking process–Five stage model–non-linearity of the five-stage model. 5 hours

Module–2

Applications of design thinking in various domains. DTF or strategic innovations Growth–Story telling representation. 5 hours

Module–3

Strategic Foresight–Change–Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design–Standardization–Humanization. 5 hours

Module–4

Creative Culture–Rapid prototyping, Strategy and Organization–Business Model design. 5 hours

Module–5

Design thinking workshop: Empathize, Design, Ideate, Prototype and Test. 5 hours

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Flipped Classes
- Activity Based Learning

Content Beyond the Syllabus:

- Course Projects
- Model Based Learning
- Activity Based Learning

Text Books:

- Stanford Design Thinking Virtual Crash Course
- Design thinking 101:Principles, Tools & Examples to transform your creative process
- https://onlinecourses.nptel.ac.in/noc19_mg60/preview
- www.tutor2u.net/business/presentations/./productlifecycle/default.html
- https://docs.oracle.com/cd/E11108_02/otn/pdf/.E11087_01.pdf
- www.bizfilings.com› Home› Marketing› Product Development
- <https://www.mindtools.com/brainstm.html>
- <https://www.quicksprout.com/./how-to-reverse-engineer-your-competitor>
- www.vertabelo.com/blog/documentation/reverse-engineering<https://support.microsoft.com/en-us/kb/273814>
- <https://support.google.com/docs/answer/179740?hl=en>
- <https://www.youtube.com/watch?v=2mjSDIBaUIMthevirtualinstructor.com/foreshortening.html>

QUESTION PAPER PATTERN:

Note:-SEE for AEC and UHV courses for 2022 scheme and DT courses will be conducted in Batch wise.

- The question paper will have fifty multiple choice questions carrying equal marks.

- Each full question carries 1 marks.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer fifty full questions, selecting one full question from each module.

Semester	IV	Course Title	Yoga	Course Code	22EC49A/49B
Teaching Period	25Hours	L – T – P–TL*	2 – 0 – 0 -2	Credits	1
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS–1					

COURSE OBJECTIVES:

The course will enable the students,

- To introduce basic wellness principles and Yogic practices for common people.
- To introduce fundamental principles and practices of Yoga for healthy living.
- To promote Yoga for disease prevention and health promotion as an approach to holistic health.

Module–1

(5 hours)

Introduction to Yoga

Introduction, G guiding principles to be followed by Yoga practitioners. Introduction to Yogic Sukshma Vyayama & Sthula Vyayama and their relevance in Yoga Sadhana. Yogic concept of Wellness and Ashtaanga Yoga of Patanjali. Concept of Wellness and Wellbeing

Module–2

(5 hours)

Concept of Wellness and Wellbeing

Yogic concept of Wellness and Ashtaanga Yoga of Patanjali. Introduction to Shatkarma and their importance in Yoga Sadhana. Health benefits of Shatkarma. Role of Yama and Niyama for Psychosocial Wellbeing. Concept of Panchakosha and Panchamahabhuta.

Module–3

(5 hours)

Health benefits of Yogasana

Introduction, Surya Namaskar: Its technique and health benefits, the role of Yogasana in diseases prevention and health promotion. Health benefits of Shatkarma. Concept of Panchakosha and Panchamahabhuta.

Module–4**(5 hours)****Pranayama**

Pranayama: Its principle and types, Mechanism of breathing, Health benefits of Pranayama, Bandha and Mudra: Techniques and their role in Yoga Sadhana. Practices of leading to Dhyana(Meditation).

Module–5**(5 hours)****Diet and Nutrition**

Yogic concepts of Aahara, Yogiclifesty (Aahara, Vihar, Aachar, Vichar). Yogic attitudes (Myhri, Karuna, Muditha and Upeksha) and practices for mental Wellbeing.

Text Books:

1. Yoga Sutras of Patanjali by Patanjali
2. Autobiography of a Yogi by Paramahansa Yogananda.
3. Bhagwat Gita.
4. Bhakti Yoga

Semester	IV	Course Title	ADDITIONAL MATHEMATICS-II	Course Code	22MATDIP41
Teaching- Period	25 Hours	L – T – P – TL*	3– 0 – 0 – 3	Credits	--
CIE*	50 Marks	SEE*	---	Total	50 Marks
CREDITS – 4					

Course objectives: The course will enable the students,

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

Module -1

(5Hours)

Linear Algebra:

Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Problems.

Module -2

(5Hours)

Numerical Methods:

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.

Module -3 (5Hours)

Higher order ODE's:

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. [Particular Integral restricted to $R(x)=e^{ax}, \sin ax / \cos ax$ for $fDyR x$.]

Module -4

(5Hours)

Partial Differential Equations (PDE's):-

Formation of PDE's by elimination of arbitrary constants and functions.

Solution of non homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Module -5

(5Hours)

Probability:

Introduction, Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems.

Course outcomes:

At the end of the course the student will be able to:

CO1: Solve systems of linear equations using matrix algebra.

CO2: Apply the knowledge of numerical methods in modelling and solving engineering problems.

CO3: Make use of analytical methods to solve higher order differential equations.

CO4: Classify partial differential equations and solve them by exact methods.

CO5: Apply elementary probability theory and solve related problems.

Textbook:

- Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 43rd Edition, 2015

Reference Books:

- Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, 10th Edition, 2015
- Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publishers, 7th Edition, 2007
- Engineering Mathematics Vol.I, Rohit Khurana, Cengage Learning, 1st Edition, 2015

Bachelor of Engineering - Electronics & Communication Engineering V SEMESTER

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination				Credits
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	22EC51	Management and Entrepreneurship	ECE	2	1	0	4	3	50	50	100	3	
2	22EC52	Principles of Communication Systems	ECE	3	1	0	5	3	50	50	100	4	
3	22EC53	IoT and Sensor Network	ECE	2	1	0	4	3	50	50	100	3	
4	22EC54	Antenna and Microwave Systems	ECE	2	1	1	5	3	50	50	100	4	
5	22EC55X	Professional Elective - I	ECE	2	1	0	4	3	50	50	100	3	
6	22ECL56	IoT and Sensors Lab	ECE	0	0	2	2	2	50	50	100	1	
7	22ECL57	Communication Lab	ECE	0	0	2	2	2	50	50	100	1	
8	22AEC58	MOC/NPTEL	ECE	0	0	2	2	2	50	50	100	1	
9	22UHV59	Constitution of India and Professional Ethics	ECE	1	0	0	1	1	50	50	100	1	
TOTAL				14	5	7	31	22	450	450	900	21	

Professional Elective - I	
22EC551	Data Structures using C++
22EC552	Information Theory Coding
22EC553	Embedded C Programming
22EC554	Satellite Communication
22EC555	Hardware Modeling using Verilog

Bachelor of Engineering - Electronics & Communication Engineering VI SEMESTER

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination			Credits
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	22EC61	Advanced Communication Systems	ECE	3	1	0	5	4	50	50	100	4
2	22EC62	ARM and Embedded Systems	ECE	2	1	0	4	3	50	50	100	3
3	22EC63	AI and ML	ECE	2	1	1	5	4	50	50	100	4
4	22EC64X	Professional Elective - II	ECE	2	1	0	4	3	50	50	100	3
5	22ECOE65X	Open Elective-I	ECE	2	1	0	4	3	50	50	100	3
6	22ECL66	Advance Communication System Lab	ECE	0	0	2	2	3	50	50	100	1
7	22ECL67	ARM & ES Lab	ECE	0	0	2	2	3	50	50	100	1
8	22AEC68	Research Methodology	HRD	0	0	2	2	2	50	50	100	1
9	22UHV69	EVS	Humanities	1	0	0	1	1	50	50	100	1
TOTAL				14	5	7	31	26				21

Open Elective-I		Professional Elective - II	
22ECOE651	Digital Electronics	22EC641	Python and its Applications
22ECOE652	Microprocessor and Microcontrollers	22EC642	Real Time Systems
22ECOE653	IOT and Sensor Networks	22EC643	PCB System Design
22ECOE654	Digital Image Processing	22EC644	Biomedical Signal Processing
22ECOE655	Principles of Communication Systems	22EC645	Micro Electro Mechanical Systems

Bachelor of Engineering - Electronics & Communication Engineering VII SEMESTER

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week					Examination			Credits
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	22EC71	Computer Networks	ECE	3	1	0	5	3	50	50	100	4
2	22EC72	VLSI Design	ECE	3	1	0	5	3	50	50	100	4
3	22EC73X	Professional Elective - III	ECE	3	1	0	5	3	50	50	100	4
4	22ECO74X	Open Elective-II	ECE	2	1	0	4	3	50	50	100	3
5	22ECL75	Computer Network Lab	ECE	0	0	2	2	3	50	50	100	1
6	22ECL76	VLSI Lab	ECE	0	0	2	2	3	50	50	100	1
7	22ECTS77	Technical Seminar	ECE	2	2	0	4	3	50	50	100	2
8	22ECPW78	Engineering Project Phase - I	ECE	0	0	2	2	2	50	50	100	2
TOTAL				15	6	6	31	23	50	50	100	21

Professional Elective - III	
22EC731	Digital Image Processing
22EC732	Power Electronics
22EC733	Analog and Mixed Mode VLSI Design
22EC734	Robotics and Automation
22EC735	Multimedia Communication

Open Elective - II	
22ECO741	Embedded System Design
22ECO742	Artificial Neural Network
22ECO743	Basic VLSI Design
22ECO744	Mobile Communication
22ECO745	Nano Electronics

Bachelor of Engineering - Electronics & Communication Engineering VIII SEMESTER

Sl. No	Course Code	Title of the Course	Teaching Department	Teaching Hours/week				Examination			Credits	
				L	T	P	TL	Duration in Hours	CIE Marks	SEE Marks		Total Marks
1	22EC81	Wireless Communication and Fiber Optics		2	1	0	3	3	50	50	100	3
2	22EC82X	Professional Elective - IV		2	1	0	3	3	50	50	100	3
4	22ECINT83	Internship		0	0	2	2	3	50	50	100	5
5	22EC84	Engineering Project Phase - 2		0	0	2	2	3	50	50	100	10
TOTAL				4	2	4	10	12	200	200	400	21

Professional Elective - IV	
22EC821	DSP Algorithm and Architecture
22EC822	ASIC Design
22EC823	Network Security
22EC824	Mobile Communication
22EC825	Nano Electronics

Management and Entrepreneurship					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Management and Entrepreneurship	Course Code	22EC51
Teaching-Period	40 Hours	L – T – P –TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

1. Explain fundamentals management functions of a manager. Also explain planning and decision-making processes.
2. Explain the organizational structure, staffing and leadership process.
3. Describe the understanding of motivation and different control systems in management.
4. Explain understanding of Innovation, Entrepreneurships and Entrepreneurship development process.
5. Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.
6. Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership and start-up in India.

:: Module 1 :: (08 Hours)

Management:

Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as art or science, art or profession - Management & Administration - Roles of Management, Levels of Management.

Planning:

Nature, importance and purpose of planning process objectives - Types of plans (meaning only), Importance of planning - steps in planning & Decision making (meaning only), Steps and limitations.

:: Module 2 :: (08 Hours)

Organizing and staffing:

Nature and purpose of organization, Principles of organization – Types of

organization, Staffing (Meaning only) Nature and importance of staffing--:
Process of Selection & Recruitment (in brief).

Social Responsibilities of Business:

Meaning of Social Responsibility, Social responsibilities of Business
Towards Different Groups, Social Performance of Business in India, Social
Audit, Business Ethics and Corporate Governance.

:: Module 3 :: (08 Hours)

Entrepreneur:

Meaning of Entrepreneur; Functions of an Entrepreneur, Types of
Entrepreneurs, Development of Entrepreneurship; Stages in entrepreneurial
process; Role of Entrepreneurship in India; Entrepreneurship – its Barriers.

Introduction to Innovation and Innovator:

Introduction, understanding Innovation, Creativity and Research, Role of
Innovation in economic growth of country, Roles of Innovator.

:: Module 4 :: (08 Hours)

Small scale industries:

Definition; Characteristics; Objectives; Scope; role of SSI in Economic
Development., Steps to start and SSI - Government policy towards SSI;
Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/
GATT, Ancillary Industry and Tiny Industry (Definition Only).

Institutional support:

Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single
Window Agency; SISI; NSIC; SIDBI; KSFC.

:: Module 5 :: (08 Hours)

Preparation of project:

Meaning of Project; Project Identification; Project Selection; Project Report;
Need and Significance of Report; Network Analysis; Errors of Project Report;
Project Appraisal.

Industrial ownership:

Definition and meaning of Partnership, Characteristics of Partnership,
Advantages and Disadvantages of Partnership, Sole proprietorship,
Advantages and Disadvantages of Sole Proprietorship.

Start-up and Entrepreneurship in India:

Starting company in India, IP landscape, Incubation, Government support, Taxation, Startup culture and leadership, Open innovation, Social Innovation, Intrapreneurship, entrepreneurship abroad.

Course outcomes

- Analyze management and functions of a manager. Also illustrate planning and decision-making processes.
- Explain the organizational structure, staffing and leadership processes.
- Describe the motivation and different control systems in management.
- Apply Innovation, Entrepreneurships and Entrepreneurship development process.
- Implement the requirements for Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.
- Develop the preparation of project report, need significance of report. Also to explain about industrial ownership and start-up in India.

Text Books

1. P. C. Tripathi, P.N. Reddy , “Principles of Management” Tata McGraw Hill.
2. Vasant Desai, “Dynamics of Entrepreneurial Development & Management” Himalaya Publishing House.
3. Poornima. M. Charantimath, “Entrepreneurship Development”, Small Business Enterprises –Pearson Education - 2006.

Reference Books

- 1 Steve Blank and Bob Dorf, “The Startup Owner’s Manual: The Step-By-Step Guide for Building a Great Company”, K&S Ranch Publishers, 2016.
- 2 Sudeendra Koushik and Pragya Dixit, “A Conversation with the Innovator in You”, Kindle Direct Publishing, Amazon, 2017. ISBN-10: 1520512716, ISBN-13: 978- 152051271.
- 3 Dr S S Khanka, S Chand “Entrepreneurial Development”, by & Company Ltd. ISBN- 10: 8121918014; ISBN-13: 978-8121918015.

Principles of Communication Systems					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Principles of Communication Systems	Course Code	22EC52
Teaching Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 5	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 04					

Course Objectives:

- Understand the simple systems for generating and demodulating AM, DSB, SSB and VSB signals.
- Discuss the concepts in Angle modulation for the design of communication systems
- Learn the various types of noise
- Evaluate the performance of the communication system in presence of noise.
- Describe the sampling, pulse modulation schemes-PAM, PWM and PPM and the multiplexing techniques FDM and TDM.

:: Module 1 :: (12 Hours)

AMPLITUDE MODULATION:

Introduction, Amplitude Modulation: Time & Frequency – Domain description, Switching modulator, Envelop detector.

DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION:

Time and Frequency – Domain Description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

SINGLE SIDE-BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION:

SSB Modulation, VSB Modulation, Frequency Translation, Frequency-Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television.

:: Module 2 :: (10 Hours)

ANGLE MODULATION:

Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band

FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing and Frequency Modulation verses Amplitude Modulation, Phase-Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. Principles of Phase Modulation.

:: Module 3 :: (08 Hours)

NOISE:

Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Signal to Noise Ratio, Noise Figure, Equivalent noise temperature, cascade connection of two-port networks.

:: Module 4 :: (10 Hours)

NOISE IN ANALOG MODULATION:

Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.

:: Module 5 :: (10 Hours)

SAMPLING AND PULSE MODULATION SYSTEMS:

Introduction, Why Digitize Analog Sources? The Sampling process, Types of Sampling. Pulse modulation schemes – PAM, PPM and PWM generation and detection Pulse code modulation. Conversion of PWM to PPM. Multiplexing Techniques - FDM and TDM.

Course outcomes

1. Explain the process of generation and detection of AM, DSBSC, SSBSC and VSBSC
2. Describe the principles of angle modulation for generating and demodulating FM signals.
3. Analyze the noise types in Communication systems
4. Develop the expressions of Figure of merit for AM and FM in communication systems
5. Determine the Nyquist sampling rate of a given signal, explain aliasing effect and compare the different pulse modulation techniques

Text Books

1. Simon Haykins & Moher, "Communication Systems", 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books

1. B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press., 4th edition.
2. Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3. H.Taub & D.L.Schilling, "Principles of Communication Systems", TMH, 2011.
4. Harold P.E, Stern Samy and A. Mahmond, "Communication Systems", Pearson Edition, 2004.
5. R.P.Singh and S.Sapre, "Communication Systems: Analog and Digital", TMH 2nd edition, 2007.

IoT and Sensor Networks					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	IoT and Sensor Networks	Course Code	22EC53
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Understand the concept of OSI Model for IoT/M2M Systems
- Analyze the architecture and design principles for device supporting IoT.
- Develop competence in programming for IoT Applications.
- Identify the uplink and downlink communication protocols which best suits the specific application of IoT / WSNs.

:: Module 1 :: (08 Hours)

Overview of Internet of Things:

IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT) for IoT/M2M devices.

:: Module 2 :: (08 Hours)

Architecture and Design Principles for IoT:

Internet connectivity, Internet based communication, IPv4, IPv6, 6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports.

Data Collection, Storage and Computing using a Cloud Platform:

Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits.

:: Module 3 :: (08 Hours)

Prototyping and Designing Software for IoT Applications:

Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server.

Introduction to IoT privacy and security: Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model.

:: Module 4 :: (08 Hours)

Wireless Sensor Networks Introduction:

Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Enabling Technologies for Wireless Sensor Networks.

WSN Architectures:

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture-Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts.

:: Module 5 :: (08 Hours)

WSN Communication Protocols:

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA, PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses.

Course outcomes

1. Discuss the choice and application of IoT & M2M communication protocols.
2. Develop the design principles in Cloud computing and IoT.
3. Evaluate the MQTT clients, MQTT server and its programming technics

4. Describe the architectures and its communication protocols of WSNs.
5. Identify the uplink and downlink communication protocols associated with specific application of IoT /WSNs.

Text Books

1. Raj Kamal, “Internet of Things-Architecture and design principles”, McGraw Hill Education.
2. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.

Reference Books

1. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols and Applications”, John Wiley, 2007.
3. Anna Hac, ‘Wireless Sensor Network Designs’, John Wiley, 2003.

Antenna and Microwave Systems					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Antenna and Microwave Systems	Course Code	22EC54
Teaching Period	50 Hours	L – T – P – TL*	2 – 1 – 1 – 5	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 04					

Course Objectives:

- Develop the basics of antenna theory and its applications.
- Understand the choice of antennas for specific applications.
- Describe the microwave properties and its transmission media.
- Understand the microwave devices for several applications.

:: Module 1 :: (10 Hours)

Antenna Basics:

Introduction, Physical concept of radiation, Patterns, beam area, Power theorem and its application radiation Intensity, beam efficiency, directivity and gain, directivity and resolution, antenna apertures, effective height, radio communication Link, Antenna field zones.

:: Module 2 :: (10 Hours)

Point Sources and Arrays:

Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Arrays of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing.

:: Module 3 :: (10 Hours)

Electric Dipoles:

Introduction, Short Electric Dipole, Fields of a Short Dipole, Radiation Resistance of a Short Electric Dipole, Thin Linear Antenna (Field Analyses)

Antenna Types:

The Helix geometry, Helix modes, Practical Design considerations for the mono-filar axial mode Helical Antenna, Yagi-Uda array, Parabolic reflector.

:: Module 4 :: (10 Hours)

Microwave Tubes:

Introduction, Reflex Klystron Oscillator, Mechanism of Oscillations, Modes of Oscillations, Mode Curve (Qualitative Analysis only)

Microwave Transmission Lines:

Microwave Frequencies, Microwave devices, Microwave Systems, Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio.

:: Module 5 :: (10 Hours)

Microwave Network theory:

Introduction, Symmetrical Z and Y-Parameters for reciprocal Networks, S matrix representation of Multi Port Networks.

Microwave Passive Devices:

Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tees.

Laboratory Experiments

1. Obtain the radiation pattern of a Yagi-Uda Antenna array and calculate its directivity
2. Obtain the near and far fields of a given antenna and compare the fields.
3. Determination of resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.
4. Determination of power division of microstrip power divider.
5. Coupling and Isolation characteristics of microstrip directional coupler.
6. Obtain the radiation pattern of a Yagi-Uda Antenna array and calculate its directivity

Course outcomes

1. Explain the concepts of antennas, electric dipole and microwave transmission.
2. Analyze the use of different types of antennas, sources, and microwave transmission lines.
3. Identify and recommend the types of antennas and microwave devices for various application.

4. Evaluate the performance parameters of point sources, antennas and microwave network
5. Design different types of sources, antennas and microwave transmission lines.

Text Books

1. Antennas and Wave Propagation- John D. Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013
2. Microwave Engineering - Annapurna Das, Sisir K Das, TMH, Publication, 2nd, 2010.
3. Microwave Devices and circuits- Samuel Y Liao, Pearson Education.

Reference Books

1. Constantine A Balanis, “Antenna Theory”, John Wiley & Sons, 2004, Second Edition.
2. David M. Pozar, “Microwave Engineering”, John Wiley, 2nd Edition, 2004.

Data structures Using C++					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Data structures Using C++	Course Code	22EC551
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Learn to Solve the problems using object-oriented approach
- Discuss the advantages of object-oriented programming over procedure-oriented programming.
- Understand the fundamentals of data structures and their applications essential for programming.
- Analyze Linear and nonlinear Data Structures: Lists, Stack, Queues and trees.

:: Module 1 :: (08 Hours)

INTRODUCTION:

Compare POPs & OOPs, Basic concepts of OOPs, C++ Structures and its applications, Tokens, Keywords, Identifiers, Variables, Data types, Operators, Expressions, Control structures.

CLASSES AND OBJECTS:

Specifying a class, C++ Program with class, friendly function, Constructors: Default, parameterized & Copy constructors, Destructors.

:: Module 2 :: (08 Hours)

INHERITANCE AND POLYMORPHISM:

Introduction, Defining derived classes, Types of Inheritance: Single, multilevel, multiple inheritance, Pointers to objects and derived classes, this pointer, Virtual and pure virtual functions.

C++ STREAMS:

C++ streams and stream classes, formatted and unformatted I/O operations, Output with manipulators.

:: Module 3 :: (08 Hours)

FUNCTIONS & PARAMETERS:

Functions and parameters, Templates, Dynamic memory allocation, Recursion.

LINEAR LISTS:

Introduction to Data structures, Types of data structures, linear list data structures, Array Representation, Linked Representation.

:: Module 4 :: (08 Hours)

STACKS:

Introduction to stacks, the abstract data types, Array Representation, Linked Representation, Applications – Parenthesis Matching & Towers of Hanoi.

QUEUES:

Introduction to Queues, The abstract data types, Array Representation, Linked Representation, Applications-Railroad car arrangement.

:: Module 5 :: (08 Hours)

TREES:

Introduction to Trees & its terminologies, Binary trees, the ADT binary tree, properties and representation of binary trees, Common binary tree operations, Binary tree traversal.

BST & PRIORITY QUEUES:

Binary search trees operations and implementation. Heaps, Applications-Heap Sorting.

Course outcomes

1. Explain the OOPs basic concepts, Class & object initialization and destroy concept using constructors and destructors.
2. Apply the concept of Inheritance, run time polymorphism by using virtual functions & I/O Operations.
3. Design Functions and parameters, Dynamic memory allocation, data structures, operations and algorithms.
4. Analyze the operations of Linear and nonlinear Data structures: List, Stack, Queue and trees and their applications.

Text Books

1. E. Balaguruswamy, “Object Oriented Programming with C++”, Tata McGraw-Hill, 8th Edition, 2020.
2. Sartaj Sahni, “Data structures, Algorithms, and applications in C++”, Universities Press, 2nd Edition, 2005.

Reference Books

1. Herbert Schmidt, “The Complete Reference C++”, Tata McGraw-Hill., 4th Edition.
2. Y. Langsam, M. Augenstein and A.M. Tenenbaum, “Data Structures using C and C++”, Prentice Hall India.
3. Ellis Horowitz, Sartaj Sahni, Dinesh Metha, “Fundamental of Data Structures in C++”, Galgotia Publications pvt. ltd. 2009.
4. D.S. Malik, Data Structures Using C++, Second Edition, Cengage Learning, 2010.

Information Theory and Coding					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Information Theory and Coding	Course Code	22EC552
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Understand the concept of Entropy, Rate of information and order of the source with reference to Dependent and independent source.
- Study various source encoding algorithms.
- Model the discrete & continuous communication channels.
- Study various type of error control coding algorithms

:: Module 1 :: (08 Hours)

Information Theory:

Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences. Markov Statistical Model for Information Sources, Entropy and Information rate of Mark off Sources.

:: Module 2 :: (08 Hours)

Source Coding:

Encoding of the Source Output, Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI, Shannon’s Encoding Algorithm, Shannon- Fano Encoding Algorithm. Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel-Ziv Algorithm.

:: Module 3 :: (08 Hours)

Information Channels:

Communication Channels, Channel Matrix, Joint probability Matrix, System Entropies. Properties of Mutual information. Channel capacity theorem with problems, Estimation of channel capacity by Muroga’s Method.

:: Module 4 :: (08 Hours)

Error Control Coding:

Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array.

:: Module 5 :: (08 Hours)

Binary Cyclic Codes:

Algebraic Structure of Cyclic Codes, Encoding using an $(n-k)$ Bit Shift register, Syndrome Calculation, Error detection and correction.

Some Important Cyclic Codes:

Golay Codes, BCH Codes.

Convolution Codes:

Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm.

Course outcomes

1. Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of Information and mark off source.
2. Analyze the Representation of information using Shannon Encoding, Shannon Fano, Prefix codes, Huffman Encoding Algorithms, Arithmetic Coding and Lempel – Ziv Algorithm.
3. Develop the Model the continuous and discrete communication channels using input, output and joint probabilities.
4. Analyze the codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes.
5. Design the Encoding and Decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.

Text Books

1. Muralidhar Kulkarni, K.S. Shivaprakasha, "Information Theory and Coding", Wiley India Pvt. Ltd, 2015, ISBN: 978-81-265-5305-1
2. K. Sam Shanmugam, "Digital and Analog communication systems", John Wiley India Pvt. Ltd, 1996.

Reference Books

1. Ranjan Bose, "ITC and Cryptography", TMH, II edition, 2007
2. J. Das, S. K. Mullick, P. K. Chatterjee, "Principles of digital communication", Wiley, 1986 - Technology & Engineering
3. Bernard Sklar, "Digital Communications Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
4. HariBhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.
5. Todd K Moon, "Error Correction Coding", Wiley Std. Edition, 2006.

Embedded C Programming					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Embedded Programming	Course Code	22EC553
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Understand the core concepts of embedded systems and their significance in various electronic devices and applications.
- Acquire practical skills in programming embedded systems using the C language, including reading from port pins, handling interrupts, and implementing structured code.
- Master techniques for meeting real-time constraints, including creating hardware delays and implementing timeout mechanisms.
- Develop proficiency in implementing multi-state systems and function sequences for complex embedded applications, as well as understanding serial communication protocols and integrating them into embedded software architectures.
- Apply the acquired knowledge and skills to design, develop, and test an intruder alarm system as a comprehensive case study.

:: Module 1 :: (08 Hours)

Programming embedded systems in C:

Introduction, what is an embedded system? Processor to choose, Programming language to choose, Choosing the Right Operating System, A guide to develop embedded software.

Overview of Microcontroller:

The external interface of the Standard 8051, Reset requirements, Clock frequency and performance, Memory Issues, I/O pins, Timers, Interrupts, Serial interface, Power consumption, A simple embedded C program.

:: Module 2 :: (08 Hours)

Reading Switches:

Introduction, Basic techniques for reading from port pins, Example: Reading

and writing bytes, Reading and writing bits (simple version), Reading and writing bits (generic version), the need for pull-up resistors, dealing with switch bounce, Example: Reading switch inputs (basic code), Counting goats.

:: Module 3 :: (08 Hours)

Adding Structure to Embedded C Code:

Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the ‘Hello Embedded World’ example, Restructuring the goat-counting example.

Meeting real-time constraints:

Introduction, creating ‘hardware delays’ using Timer 0 and Timer 1, Example: Generating a precise 50 ms delay, the need for ‘timeout’ mechanisms, creating loop timeouts, Example: Testing loop timeouts, creating hardware timeouts, Example: Testing a hardware timeout.

:: Module 4 :: (08 Hours)

Multi-state systems and function sequences:

Introduction, implementing a Multi-State (Timed) system, Example: Traffic light sequencing, Example: Animatronic dinosaur, Implementing a Multi-State (Input/Timed) system, Example: Controller for a washing machine.

:: Module 5 :: (08 Hours)

Serial Interface:

Introduction, RS232, Asynchronous data transmission and baud rates, Flow control, the software architecture, Using the on-chip UART for RS-232 communications, Memory requirements.

Case study - Intruder alarm system:

Introduction, the software architecture, Key software components used in this example, Running the program, the software.

Course outcomes

1. Demonstrate a comprehensive understanding of embedded systems and apply the principles of embedded C programming to effectively utilize microcontroller peripherals.
2. Implement structured programming techniques and object-oriented principles in embedded C code to enhance code organization,

readability, and maintainability, ensuring the scalability and longevity of embedded software projects

3. Evaluate the effectiveness of different real-time programming techniques in ensuring the responsiveness and reliability of embedded systems in time-critical applications.
4. Apply the proficiency in data transmission, flow control, and memory management, and effectively communicate with external devices or systems by Integrating serial communication protocols such as RS232 into embedded software architectures.
5. Design and test a complete embedded system solution, such as an intruder alarm system, showcasing proficiency in embedded C programming, system integration, and software architecture design.

Text Books

1. Michael J. Pont, “Embedded C”, Addison Wesley, 2002.

Reference Books

1. Jivan S. Parab, Vinod G. Shelake, Rajanish K.Kamot, and Gourish M.Naik “Exploring C for Microcontrollers- A Hands on Approach”, , Springer.
2. Daniel W. Lewis, “Fundamentals of embedded software where C and assembly meet”, Pearson Education, 2002
3. David E. Simon, “An Embedded Software Primer”, Pearson Education, 2003.
4. Kernighan, Brian W, Ritchie, Dennis Ritchie, “C Programming language”, Prentice Hall, 2nd Edition.

Satellite Communication					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Satellite Communication	Course Code	22EC554
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Learn the basic principle of satellite orbits and trajectories.
- Study of electronic systems associated with a satellite and the earth station.
- Study of electronic systems associated with a satellite and the earth station.
- Acquire the knowledge about communication satellite and the national satellite system.
- Study of satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

:: Module 1 :: (08 Hours)

Satellite Orbits and Trajectories:

Definition, Basic Principles-newton’s laws and Kepler’s laws, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite’s performance, Eclipses, Look angles: Azimuth angle, Elevation angle.

:: Module 2 :: (08 Hours)

Satellite Hardware:

Satellite subsystems- mechanical structure, propulsion subsystem, thermal control subsystem, power supply subsystem, Tracking, Telemetry and command subsystem, Attitude and orbit control subsystem, payload subsystem, antenna subsystem.

Earth Station:

Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.

:: Module 3 :: (08 Hours)

Multiple Access Techniques:

Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA.

Satellite Link Design Fundamentals:

Transmission Equation, Satellite Link Parameters, propagation considerations.

:: Module 4 :: (08 Hours)

Communication Satellites:

Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, regional satellite Systems, National Satellite Systems.

:: Module 5 :: (08 Hours)

Remote Sensing Satellites:

Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications.

Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications. **Navigation Satellites:** Development of Satellite Navigation Systems, GPS system, Applications.

Course outcomes

1. Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
2. Design the electronic hardware systems associated with the satellite subsystem and earth station, Encoding and Decoding circuits for various types of Block codes
3. Analyze the various applications of satellite with the focus on national satellite system.
4. Evaluate the satellite link parameters under various propagation conditions with the illustration of multiple access techniques.

Text Books

1. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81- 265-2071-8

Reference Books

1. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2. Timothy Pratt, Charles Bostian, Jeremy Allnut, Satellite Communications, 2nd Edition, Wiley India Pvt Ltd , 2017, ISBN: 978-81-265-0833-4

Hardware Modeling Using Verilog					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Hardware Modeling Using Verilog	Course Code	22EC555
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Understand the concepts of Verilog Language.
- Design the digital systems as an activity in a larger systems design context.
- Study the design and operation of semiconductor memories frequently used in application specific digital system.
- Interpret about how effectively ICs are embedded in package and assembled in PCBs for different application.
- Acquire the knowledge in diagnosis of processors and I/O controllers used in embedded systems.

:: Module 1 :: (08 Hours)

Introduction and Methodology: Digital Systems and Embedded Systems, Real-World Circuits, Models, Design Methodology.

Combinational Basics: Combinational Components and Circuits, Verification of Combinational Circuits.

Sequential Basics: Sequential Datapath's and Control Clocked Synchronous Timing Methodology.

:: Module 2 :: (08 Hours)

Memories: Concepts, Memory Types, Error Detection and Correction.

:: Module 3 :: (08 Hours)

Implementation Fabrics: Integrated Circuits, Programmable Logic Devices, Packaging and Circuit boards, Interconnection and Signal integrity.

:: Module 4 :: (08 Hours)

I/O interfacing: I/O devices, I/O controllers, Parallel Buses, Serial Transmission, I/O software.

:: Module 5 :: (08 Hours)

Design Methodology: Design flow, Design optimization, Design for test, Nontechnical Issues.

Course outcomes

1. Develop the combinational circuits, using discrete gates and programmable logic devices.
2. Describe how arithmetic operations can be performed for each kind of code, and also combinational circuits that implement arithmetic operations.
3. Design a semiconductor memory for specific chip design and embedded systems using small microcontrollers.
4. Distinguish different types of I/O controllers that are used in embedded system.

Text Books

1. Peter J. Ashenden, “Digital Design: An Embedded Systems Approach Using VERILOG”, Elsevier, 2010.

Reference Books

1. Ming-Bo Lin, “Digital System Designs and Practices: Using Verilog HDL and FPGAs”, Wiley, 2008
2. Charles Roth, Lizy K. John, “Byeong KilLee Digital Systems Design Using Verilog, Cengage”, Cengage, 1st Edition.
3. Donald E. Thomas, Philip R. Moorby, “The Verilog Hardware Description Language”, Springer, Fifth edition.
4. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL” Pearson (Prentice Hall), Second edition.

IoT and Sensors Lab					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	IoT and Sensors Lab	Course Code	22ECL56
Teaching Period	24 Hours	L – T – P – TL*	0 – 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 01					

Course Objectives:

- Gain hands-on experience in interfacing sensors with microcontrollers or single-board computers commonly used in IoT projects.
- Acquire knowledge and skills in interfacing LCD or OLED displays with Arduino/Raspberry Pi and writing programs to display sensor data, enabling students to visualize and present sensor readings effectively.
- Learn the concept of Bluetooth communication with Arduino/Raspberry Pi and develop proficiency in writing programs to transmit sensor data to smartphones and control devices remotely, enabling students to implement wireless communication solutions for IoT applications.
- Learn methods for acquiring data from sensors and transmitting it to IoT platforms or cloud services for analysis and visualization.

:: Laboratory Experiments ::

1. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 5 seconds after every 2 seconds.
2. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
3. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
4. To interface LCD or OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
5. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
6. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.

7. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to Thingspeak cloud.
8. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from Thingspeak cloud.
9. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
10. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.

Course outcomes

1. Demonstrate understanding of various electronic components and their functionalities within IoT systems by successfully interfacing LEDs, buzzers, sensors, motors, and displays with Arduino/Raspberry Pi.
2. Interpret and explain how to program microcontrollers (Arduino/Raspberry Pi) to perform specific tasks, including controlling output devices, reading sensor data, and interfacing with external devices.
3. Apply knowledge and skills to design and implement IoT applications by writing programs to automate processes based on sensor inputs.
4. Analyze wireless communication protocols (Bluetooth) and establish connections between IoT devices and smartphones, demonstrating the ability to remotely monitor and control sensor data.
5. Evaluate IoT cloud platforms and protocols for data transmission, storage, and retrieval, and demonstrate proficiency in integrating IoT devices with cloud services for data management and analysis.

Communication Lab					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	V	Course Title	Communication Lab	Course Code	22ECL57
Teaching Period	24 Hours	L – T – P – TL*	0– 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 01					

Course Objectives:

- Design, Demonstrate and Analyze instrumentation amplifier, filters, DAC, adder, differentiator and integrator circuits, using op-amp.
- Design, Demonstrate and Analyze multivibrator and oscillator circuits using Op-amp.
- Design, Demonstrate and Analyze Analog systems for AM, FM and Mixer operations.
- Design, Demonstrate and Analyze balance modulation and frequency synthesis. Demonstrate and Analyze pulse sampling and flat top sampling.

:: Laboratory Experiments ::

1. Design an instrumentation amplifier of a differential mode gain of $_A$ using three amplifiers.
2. Design of RC Phase shift and Wien ‘s bridge oscillators using Op-amp.
3. Design active second order Butterworth low pass and high pass filters.
4. Design 4-bit R – 2R Op-Amp Digital to Analog Converter
 - (i) using 4-bit binary input from toggle Switches and
 - (ii) by generating digital inputs using mod-16 counter.
5. Design Adder, Integrator and Differentiator using Op-Amp.
6. Design of Monostable and Astable Multivibrator using 555 Timer.
7. Demonstrate Pulse sampling, flat top sampling and reconstruction.
8. Amplitude modulation using transistor/FET (Generation and detection).
9. Frequency modulation using IC 8038/2206 and demodulation.
10. Design BJT/FET Mixer.
11. DSBSC generation using Balance Modulator IC 1496/1596.
12. Frequency synthesis using PLL.

Course outcomes

1. Analyse the working of differential amplifier, filters and calculate cut off frequency and roll off of filters and design oscillators for any frequency.
2. Design of mod-16 counter, adder and integrator and differentiator for suitable applications.
3. Design the 555 timer for various applications such as amplitude modulation, frequency modulation and pulse amplitude modulation.
4. Experiment on the developed hands-on device such as DSBSC generation, Mixer and PLL working.

Communication Lab					
Semester- V [As Per Choice Based System (CBCS) Scheme]					
Semester	VI	Course Title	Advanced Communication Systems	Course Code	22EC61
Teaching Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 5	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 04					

Course Objectives:

This course will enable students

1. Understand and appreciate the need of various modulation and spread spectrum techniques.
2. Analyze the properties of basic Modulation techniques and apply them to Digital Communication
3. Apply different types of coding techniques to design the optimum receiver for channels with ISI and AWGN.
4. Design and develop the different types of modulation techniques, equalizer to improve the performance under fading channels for various applications.

MODULE – 1

Digital Modulation Techniques

Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature – modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ary modulation techniques, Power spectra, Bandwidth efficiency, M-ary modulation formats viewed in the light of the channel capacity theorem, Effect of inter symbol interference, Bit versus symbol error probabilities, Synchronization, Applications.

MODULE – 2

Coding Techniques

Convolutional encoding, Convolutional encoder representation, Formulation of the convolutional decoding problem, Properties of convolutional codes: Distance property of convolutional codes, Systematic and nonsystematic

convolutional codes, Performance Bounds for Convolutional codes, Coding gain, Other convolutional decoding algorithms, Sequential decoding, Feedback decoding, Turbo codes.

MODULE – 3

Linear and Adaptive Equalization

Linear equalization, Decision -feedback equalization, Reduced complexity ML detectors, Iterative equalization and decoding - Turbo equalization. Adaptive linear equalizer, adaptive decision feedback equalizer, Recursive least square algorithms for adaptive equalization.

MODULE – 4

Spread spectrum signals for digital communication

Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spread spectrum signals, Time hopping SS, Synchronization of SS systems.

MODULE – 5

Digital Communication through Fading Multipath Channels

Characterization of fading multipath channels, The effect of signal characteristics on the choice of a channel model, Frequency nonselective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel.

Course Outcomes:

After studying this course the student should be able to:

- Explain merits and demerits of different modulation techniques & coding techniques, spread spectrum signals and channel behaviors
- Analyze various modulation, equalization, diversity and coding techniques for communication systems
- Compare performance of different types of modulation on different wireless application fading channels.
- Design and demonstrate various modulation/coding equalization techniques and measure their performance.

Text Book:

1. Simon Haykin, “Digital Communication”, Reprint, Wiley, 2013, ISBN: 0471647357 9780471647355.
2. John G. Proakis, “Digital Communications”, McGraw Hill, 5th Edition, 2008.

Reference Books:

1. Bernard Sklar, “Digital Communications - Fundamentals and Applications”, Pearson Education (Asia) Pvt. Ltd, 2nd Edition, 2014, ISBN: 1292026065, 9781292026060.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

Semester	VI	Course Title	ARM and Embedded Systems	Course Code	22EC62
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students to:

1. Understand the architecture and applications of ARM Cortex M3.
2. Understand the need of embedded software development and development suites.
3. Explain the different instruction sets used to code ARM Cortex M3 Controller.
4. Analyze the different components of Embedded systems and explain communication types.
5. Explain the embedded firmware and RTOS design for embedded systems.

MODULE – 1

ARM Cortex Processor: ARM Cortex M3 processors, advantages of Cortex M processors, Applications of Cortex-M Processors, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, Operation modes, Stack operation, Memory map, NVIC, Exceptions and Interrupts, Vector tables, Bus interface Reset sequence.

MODULE – 2

ARM Embedded Software Development: Inside ARM, Development suites, Development boards, Development adaptors, Software device drivers, Software development flow, Compiling, Software flow, Microcontroller Interface,

The Cortex microcontroller software interface standard (CMSIS) : Introduction of CMSIS, Use CMSIS-Core, Benefits of CMSIS-Core.

MODULE – 3

THUMB instruction set: Introduction to Thumb-2 technology, advantages of Thumb-2 instruction set, Instruction set in ARM, Basics of assembly language syntax, Use of suffix in instruction, Unified assembly language (UAL).

Instruction set: Moving data within the processor, Memory access instructions, Arithmetic operations, Logic operations, Shift and rotate instructions.

MODULE – 4

Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, IrDA, Bluetooth, Wi-Fi, Zigbee only).

MODULE – 5

Embedded Firmware Design and Development: Embedded Operating System based approach, Embedded Firmware Development Languages: Source File to Object File Translation, Assembly language to machine language conversion process and High level language to machine language conversion process, Advantages of Assembly Language Based Development RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Real time Kernel, Process States & State Transition, Threads.

Course Outcomes:

After studying this course the student should be able to:

- Discuss the architectural features of ARM Cortex M3 Processor.
- Explain the software development suites and interface standards.
- Interpret the knowledge of Thumb instruction set to program ARM Cortex controllers for different applications.
- Describe the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.

- Implement the knowledge of firmware design and explain the need of real time operating system for embedded system applications.

Text Book:

1. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 3rd Edition, Newnes, (Elsevier), 2010.
2. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 3rd Edition.

Reference Books:

1. James K. Peckol, “Embedded systems- A contemporary design tool”, John Wiley, 2008, ISBN: 978-0- 471-72180-2.
2. Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C”, 2nd E -Man Press LLC ©2015 ISBN:0982692633 9780982692639.
3. Embedded Systems by Rajkamal, 2nd Edition, McGraw hill Publications, 2010

Semester	VI	Course Title	AI and ML	Course Code	22EC63
Teaching Period	50 Hours	L – T – P – TL*	2 – 1 – 1 – 5	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 04					

Course Objectives:

This course will enable students

1. Gain a historical perspective of AI and its foundations.
2. Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
3. Understand some concepts and techniques that are core to Machine Learning and decision tree.
4. Acquire knowledge of neural networks, Bayesian techniques and instant based learning.
5. Understand analytical learning and reinforced learning.

MODULE – 1

Introduction: Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I.

Solving Problems by Searching, Study and analysis of Various searching algorithms. Implementation of Depth-first search Problem Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search. Informed search Strategies: A* Search Strategy.

MODULE – 2

Knowledge, Reasoning And Planning: Logical Agents - Knowledge-based agents, Logic, Propositional Logic; First-Order Logic –Representation, Syntax and Semantics, Using First-Order Logic; Inference in First-Order Logic –Unification, Forward Chaining, Backward Chaining, Resolution.

MODULE – 3

Introduction: Learning Problems, Designing Learning systems, Perspectives and Issues.

Concept Learning: Concept Learning task and concept learning as search, Find-S, VersionSpaces and Candidate Elimination Algorithm.

Decision Tree learning: Representation, Basic Algorithm and Hypothesis Space Search.

MODULE – 4

Artificial Neural Networks: Introduction, Neural network representation, perceptron's, Multilayer network and the back propagation algorithm.

Bayesian learning: Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes, Bayesian belief algorithm.

MODULE – 5

Instant Based Learning: K- Nearest Neighbor Learning Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning. Sequential Covering Algorithms, K- Means algorithm.

Clustering:K-Means Algorithm.

Laboratory Component

- Implement the following algorithms (5 to 8) using required statistical formulae and do not use direct API's
- Demonstrate the working of the algorithms by considering appropriate datasets
- Display the values of all the model parameters

Sl.No.Experiment Title

- 1 Solve the Tic-Tac-Toe problem using the Depth First Search technique.
- 2 Demonstrate the working of Alpha-Beta Pruning.
- 3 Solve the 8-Puzzle problem using the A* algorithm
- 4 Implement a Hill-climbing search algorithm to maximize a single variable function $f(x)$.
- 5 Logistic regression algorithm.
- 6 Naïve Bayes Classifier
- 7 KNN algorithm.
- 8 K- means algorithm

Course Outcomes:

After studying this course the student should be able to:

- Explain and apply AI and ML algorithms to address various requirements of real- world problems.
- Design and develop AI and ML solutions to benefit society, science, and industry.
- Use modern tools to create AI and ML solutions.
- Demonstrate effective communication through team presentations and reports to analyze the impact of AI and ML solutions on society and nature.
- Conduct performance evaluation, modeling, and validation of AI and ML solutions benefiting lifelong learning.

Text Book:

1. Artificial Intelligence: A Modern Approach by Peter and Norvig ISBN-0-13- 1038052
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair ISBN-978-0-07- 008770-5, TMH,
2. Artificial Intelligence Basics: A Self Teaching Introduction, Neeru Gupta and RamitaMangla, Mercury Learning and Information, 1st Edition, 2020, ISBN: 978-1- 68392-516-3.

Semester	VI	Course Title	Python and its Applications	Course Code	22EC641
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. Learn Syntax and Semantics and create Functions in Python.
2. Handle Strings and Files in Python.
3. Understand Lists, Dictionaries and Regular expressions in Python.
4. Implement Object Oriented Programming concepts in Python.
5. Build Web Services and introduction to Network and Database Programming in Python.

MODULE – 1

INTRODUCTION: Introduction to Python and its features, Variables, Identifiers, Keywords, Data types, Operators & operands, Expressions and operator precedence, Modulus operator, String operations, Comments

FUNCTIONS: Function calls, Built-in functions, Type conversion functions, Random numbers, Math functions, Adding new functions, Definition and uses, Flow of execution, Parameters and arguments, Fruitful functions and void functions.

MODULE – 2

CONDITIONAL EXECUTION & RECURSION: Conditional execution (if), alternative execution (if-else), chained conditionals (if-elif-else), nested conditionals, recursion.

ITERATION: The while statement, Infinite Loops, “Infinite Loops” and break, Finishing iterations with continue, Definite loops using for.

STRING: string slices, immutability, searching, looping and counting, string methods.

MODULE – 3

LIST: List operations, list slices, list methods, list loop, mutability, aliasing, list arguments, list and tuples.

DICTIONARIES: A dictionary is a mapping, dictionary as a collection of counters, looping and dictionaries, reverse look up, dictionaries and lists, memos.

MODULE – 4

TUPLES: Tuples are immutable, tuple assignment, tuples are return values, variable- length argument tuples, list and tuples, dictionaries and tuples.

FILES: Files reading and writing, format operator, file names and paths, catching exceptions, pickling and pipes, writing modules.

MODULE – 5

Creating the GUI Form and Adding Widgets: GUI, Buttons and callbacks, Canvas widgets, Menus and Callable.

Python Libraries: NumPy, Introduction to NumPy, Creating arrays, Indexing Arrays, Array Transposition, Pandas and Data Visualization: Introduction, Series and Data Frames in pandas and Data Visualization.

Course Outcomes:

After studying this course the student should be able to:

- Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases.

Text Book:

1. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, Create Space Independent Publishing Platform, 2016.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd Edition, GreenTea Press, 2015.
3. Travis E. Oliphant, “Guide to NumPy”, Trelgol publishers, 2006.

Reference Books:

1. Charles Dierbach, “Introduction to Computer Science Using Python”,1st Edition, Wiley IndiaPvt Ltd, 2015. ISBN-13: 978-81265560142.
2. Gowrishankar S, Veena A, “Introduction to Python Programming”, 1st Edition, CRC Press/Taylor& Francis, 2018. ISBN-13: 978-08153943723.
3. Mark Lutz, “Programming Python”,4th Edition, O’Reilly Media, 2011. ISBN-13: 978-3502328734.
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithmsin Python”,1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978- 81265621765.
5. ReemaThareja, “Python Programming Using Problem Solving Approach”, Oxford universitypress, 2017. ISBN-13: 978-0199480173.
6. Tony Gaddis ,”Starting Out with Python”, Pearson 5th Edition, 2021, ISBN-13: 9780136679110

Semester	VI	Course Title	Real Time Systems	Course Code	22EC642
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. Discuss the historical background of Real-time systems and its classifications.
2. Describe the concepts of computer control and hardware components for Real Time Application.
3. Discuss the languages to develop software for Real-Time Applications.
4. Explain the concepts of operating system and RTS development methodologies.

MODULE – 1

Introduction to Real-Time Systems: Historical background, Elements of a Computer Control System, RTS- Definition, Classification of Real-time Systems, Time Constraints, Classification of Programs. Concepts of Computer Control: Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems.

MODULE – 2

Computer Hardware Requirements for Real - Time Applications: Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface.

MODULE – 3

Languages for Real-Time Applications: Introduction, Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Modularity and Variables, Compilation of Modular Programs, Data types, Control Structures, Exception Handling, Low-level facilities, Co-routines, Interrupts and Device Handling, Concurrency, Real Time Support, Overview of Real-Time Languages.

MODULE – 4

Operating Systems: Introduction, Real-Time Multi-Tasking OS, Scheduling Strategies, Priority Structures, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Memory Management, Code Sharing, Resource Control, Task Co-Operation and Communication, Mutual Exclusion.

MODULE – 5

Design of RTS – General Introduction: Introduction, Specification Document, Preliminary Design, Single-Program Approach, Foreground/Background System. RTS Development Methodologies: Introduction, Yourdon Methodology, Ward and Mellor Method, Hatley and Pirbhai Method.

Course Outcomes:

After studying this course the student should be able to:

- Discuss the fundamentals of Real time systems and its classifications.
- Analyse the concepts of computer control, operating system and the suitable computer hardware requirements for real-time applications.
- Develop the software languages to meet Real time applications.
- Apply suitable methodologies to design and develop Real-Time Systems.

Text Book:

1. Real-Time Computer Control, by Stuart Bennet, 2nd Edition. Pearson Education. 2008.

Reference Books:

1. C.M. Krishna, Kang G. Shin, —Real –Time Systems, McGraw –Hill International Editions, 1997.
2. Real-Time Systems Design and Analysis, Phillip. A.Laplante, second edition, PHI, 2005.
3. Embedded Systems, Raj Kamal, Tata McGraw Hill, India, third edition, 2005.

Semester	VI	Course Title	PCB System Design	Course Code	22EC643
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. Study about layout planning, art work and design of PCB.
2. To understand the PCB production process.
3. Discuss the role of Modern trends and automatic design of PCB.

MODULE – 1

Design of Printed Circuit Boards: Layout Planning: Introduction, General Consideration, PCB Sizes, Layout Approaches, Documentation.

Layout, General Rules and Parameters: Introduction, Resistance, Capacitance, Inductance of PCB conductors, Conductor Spacing, Component Placing and Mounting, Cooling Requirements and Package Density, Layout Check, Artwork.

MODULE – 2

Technology of PCB: Film Master Production: Introduction, Emulsion Parameters, Film Emulsions, Dimensional Stability of Film Masters, Reprographic Cameras, Darkroom, Film Processing, Film Registration.

Properties of Copper Clad Laminates: Introduction, Manufacture of Copper Clad Laminates, Properties and Types of Laminates, Specifications and Test Methods.

Board cleaning before Pattern Transfer: Manual and Machine Cleaning Processes.

MODULE – 3

Photo printing: Basic Processes for Double Sided PCBs, Photoresists, Wet Film Resists, Coating Processes, Exposure and further Processing of Wet Film Resists, Dry Film Resists.

Screen Printing: Screen Fabrics, Screen and Frame Preparation, Pattern Transfer onto the screen, Reclamation of the Screen Fabrics, Printing, Trouble shooting.

MODULE – 4

Plating: Introduction, Immersion Plating, Electroless Plating, Electroplating, Plating Quality Control, Etching, Etching Machines, Etchant Systems, Minimizing Pollution, Mechanical Machining operations.

Multilayer Boards: Introduction, Design and Test Considerations, Multilayer Construction, Equipment, Laminating Process and further processing.

MODULE – 5

PCB Technology Trends: Fine line conductors with Ultra-Thin Copper Foil, Multilayer and Multiwire Boards, Flexible Printed Circuit Boards. Automation and Computers in PCB.

Design: Automated Artwork Drafting, Computer Aided Design, Design Automation.

Course Outcomes:

After studying this course the student should be able to:

- Define the detailed circuit diagram and prerequisite before the actual PCB layout.
- Understand the process of PCB production and Material selection
- Understand the PCB fabrication by transferring the conductor pattern on base material
- Know about the Plating techniques, Etching process and multilayer PCB board construction
- Understand about new streams in PCB technology and modern facilities for PCB design.

Text Book:

1. Printed Circuit Boards-Design & Technology by Walter C Bosshart, Tata McGraw- Hill Pvt.Ltd, 2010
2. Printed Circuit Boards-Design, Fabrication, Assembly and Testing by Dr.R.S. Khandapur, McGraw-Hill Education, 2017.

Reference Books:

1. Montrose, Mark. EMC and the Printed Circuit Board. John Wiley & Sons, 2004.
2. Christopoulos, Christos. Principles and Techniques of Electromagnetic Compatibility. CRC Press, 2018.

Semester	VI	Course Title	Biomedical Signal Processing	Course Code	22EC644
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. To Make Students Understand the Sources, Types & Characteristics of Different Noises and Artifacts Present in Biomedical Signals.
2. To Make Students Able to Design Time Domain and Frequency Domain Filters for Noise and Artifact Removal from Biomedical signals.
3. To Make Students Able to Understand and Apply Various Methods for Analyzing Biomedical Signal Characteristics.
4. To Motivate Students to Explore Alternative Techniques of Analyzing Biomedical Signals in Time and Frequency Domain.

MODULE – 1

Introduction to Biomedical Signals: Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals Like: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Event-Related Potentials (ERPS), Electrogastrogram (EGG), Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.

MODULE – 2

Removal of Noise and Artifacts from Biomedical Signal: Random and Structured Noise, Physiological Interference, Stationary and Nonstationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering.

MODULE – 3

EEG Signal Processing and Event Detection in Biomedical Signals: EEG Signal and Its Characteristics, EEG Analysis, Linear Prediction Theory, Autoregressive Method, Sleep EEG, Application of Adaptive Filter for Noise

Cancellation in ECG and EEG Signals; Detection of P, Q, R, S and T Waves in ECG, EEG Rhythms, Waves and Transients, Detection of Waves and Transients, Correlation Analysis Ad Coherence Analysis of EEG Channels.

MODULE – 4

Analysis of Nonstationary Signals: Heart Sounds and Murmurs, Characterization of Nonstationary Signals and Dynamic Systems, Short-Time Fourier Transform, Considerations in Short-Time Analysis and Adaptive Segmentation.

MODULE – 5

Direct data compression techniques: Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

Course Outcomes:

After studying this course the student should be able to:

- Discuss the origin, nature and characteristics of biomedical signals
- Identify and analyze the noise and artifacts in biomedical.
- Evaluate various event detection techniques for the analysis of the EEG and ECG.
- Apply different data compression techniques on biomedical Signals

Text Book:

1. Rangayyan, R.M., 2015. Biomedical signal analysis (Vol. 33). John Wiley & Sons.
2. Reddy, D.C., 2005. Biomedical signal processing: principles and techniques. McGraw-Hill

Reference Books:

1. Biomedical signal analysis- A case study approach, Rangayyan Rangaraj, Wiley Interscience (IEEE Press)-2005
2. Tompkins, W.J., 1993. Biomedical digital signal processing. Editorial Prentice Hall.
3. Sornmo, L. and Laguna, P., 2005. Bioelectrical signal processing in cardiac and neurological applications (Vol. 8). Academic Press.

Semester	VI	Course Title	Micro Electro Mechanical Systems	Course Code	22EC645
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. To prepare students with fundamental knowledge/ overview in the field of MicroElectro Mechanical Systems.
2. To equip students with a basic foundation in electronic engineering, mechanical engineering, electrical engineering, chemistry, physics and mathematics fundamentals required for comprehending the operation and application of MEMS circuits and design.
3. To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

MODULE – 1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

MODULE – 2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics. Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry.

Engineering Science for Microsystems Design and Fabrication: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry.

MODULE – 3

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin Film Mechanics, and Overview on Finite Element Stress Analysis.

MODULE – 4

Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid- Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

MODULE – 5

Overview of Micro manufacturing: Introduction, Bulk Micro manufacturing, Surface Micromachining, The LIGA Process, Summary on Micro manufacturing.

Course Outcomes:

After studying this course the student should be able to:

- Explain the technologies related to Micro Electro Mechanical Systems.
- To design and fabrication processes involved with MEMS Devices.
- Analyze the MEMS devices and develop suitable mathematical models.
- Explain the various application areas for MEMS device.
- Describe and analyze the Micro manufacturing process.

Text Book:

1. Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.

Reference Books:

1. Hans H. Gatzert, Volker Saile, Jurg Leuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cengage Learning.

Semester	VI	Course Title	Digital Electronics	Course Code	22ECOE651
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. To understand and analyze the number conversions and logic gates.
2. To describe, illustrate and analyze combinational logic circuits, simplification of algebraic equations using karnaugh maps and quinemclusky techniques.
3. To describe and design decoders, encoders, digital multiplexers, adders and subtractors, binary comparators, latches and master-slave flip-flops.
4. To explain and design memory devices, A/D and D/A converters.

MODULE – 1

Number Systems: Binary, Octal, Decimal, Hexadecimal. Number base conversions, 1's, 2's complements, signed Binary numbers. Binary Arithmetic, Binary codes: Weighted BCD, Gray code, Excess 3 code, ASCII. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive-OR and Exclusive-NOR. Implementations of Logic Functions using gates, NAND-NOR implementations.

MODULE – 2

Boolean Algebra: Boolean postulates and laws – De-Morgan's Theorem, Principle of Duality, Boolean expression – Boolean function, Minimization of Boolean expressions – Sum of Products (SOP), Product of Sums (POS), Minterm, Maxterm, Canonical forms, Conversion between canonical forms, Karnaugh map Minimization, Don't care conditions, Quine-McCluskey method.

MODULE – 3

Combinational Circuits: Design procedure – Adders, Subtractors, BCD adder, Magnitude Comparator, Multiplexer/Demultiplexer, encoder/decoder, parity checker, code converters.

Sequential Circuits: Flip flops SR, JK, T, D and Master slave, Excitation table, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops.

MODULE – 4

Memory Devices: Classification of memories, RAM organization, Write operation, Read operation, Memory cycle. ROM organization, PROM, EPROM, EEPROM, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

MODULE – 5

A/D & D/A Convertors: Analog & Digital signals. sample and hold circuit, A/D and D/A conversion techniques (Weighted type, R-2R Ladder type, Counter Type, Dual Slope type, Successive Approximation type).

Course Outcomes:

After studying this course the student should be able to:

- Demonstrate the operation of simple digital gates, identify the symbols.
- Develop the truth table for those gates; combine simple gates into more complex circuits; change binary, hexadecimal, octal numbers to their decimal equivalent and vice versa.
- Demonstrate the operation of a flip-flop.
- Study different types of memories and their applications. Convert digital signal into analog and vice versa.

Text Book:

1. Morris Mano, Digital Design, Prentice Hall of India Pvt. Ltd
2. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 5ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
3. R.P. Jain, Modern Digital Electronics, 3ed., Tata Mc Graw-Hill publishing company limited, New Delhi, 2003.

Reference Books:

1. Thomas L. Floyd, Digital Fundamentals, Pearson Education, Inc, New Delhi, 2003
2. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, Digital System - Principles and Applications, PearsonEducation.

Semester	VI	Course Title	Microprocessors and Microcontroller	Course Code	22ECOE652
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students to:

1. To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
2. To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
3. To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

MODULE – 1

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

MODULE – 2

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters.

MODULE – 3

I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

MODULE – 4

Stack and Interrupts: Stack Operation, Basics of Interrupt, Interrupt Vector Table, Level Triggered Interrupt, Edge Trigger Interrupt, Interrupt Priority.

MODULE – 5

Basics of 8086 Microprocessor: Architecture of 8087, 8088 Microprocessor Vs 8086Microprocessor, Von-Neumann & Harvard CPU architecture, CISC and RISC CPU architecture. INT 21h DOS Function Call - for handling Keyboard and Display.

8086 Bus Configuration and Timings: General Bus operation cycle, Minimum mode 8086 system and Timing diagrams, Maximum Mode 8086 system and Timing diagrams.

Course Outcomes:

After studying this course the student should be able to:

- Understand the internal architecture and organization of 8086
- Analyze the Assembly language programs of 8086
- Analyze the internal architecture, Stacks and Interrupts of 8051.
- Discuss the input /output, memory interface, Serial Communication and Bus Interface devices
- Discuss the 8086 bus configuration and Dos functions call.

Text Book:

1. “The 8051 Microcontroller and Embedded Systems – using assembly and C”, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
2. “The 8051 Microcontroller”, Kenneth J. Ayala, 3rd Edition, Thomson/ Cengage Learning.

Reference Books:

1. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.

Semester	VI	Course Title	IoT & Sensor Networks	Course Code	22ECOE653
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 03					

Course Objectives:

This course will enable students

1. Describe the OSI Model for IoT/M2M Systems
2. Understand the architecture and design principles for device supporting IoT.
3. Develop competence in programming for IoT Applications.
4. Identify the uplink and downlink communication protocols which best suits the specific application of IoT / WSNs.

MODULE – 1

Overview of Internet of Things: IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT) for IoT/M2M devices.

MODULE – 2

Architecture and Design Principles for IoT: Internet connectivity, Internet based communication, IPv4, IPv6, 6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports. Data Collection, Storage and Computing using a Cloud Platform: Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits.

MODULE – 3

Prototyping and Designing Software for IoT Applications: Introduction, Prototyping Embedded device software, Programming Embedded Device

Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server.

Introduction to IoT privacy and security: Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model.

MODULE – 4

Wireless Sensor Networks Introduction: Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Enabling Technologies for Wireless Sensor Networks.

WSN Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts.

MODULE – 5

WSN Communication Protocols: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA, PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses.

Course Outcomes:

After studying this course the student should be able to:

- Understand choice and application of IoT& M2M communication protocols.
- Describe Cloud computing and design principles of IoT.
- Relate to MQTT clients, MQTT server and its programming.
- Describe the architectures and its communication protocols of WSNs.
- Identify the uplink and downlink communication protocols associated with specific application of IoT /WSNs

Text Book:

1. Raj Kamal, "Internet of Things-Architecture and design principles", McGraw Hill Education.
2. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

Reference Books:

1. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols and Applications", John Wiley, 2007.
3. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

Semester	VI	Course Title	Digital Image Processing	Course Code	22ECOE654
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 03					

Course Objectives:

This course will enable students

1. Understand the fundamentals of digital image processing.
2. Understand the image transforms and spatial Filtering used in digital image processing.
3. Understand the image enhancement techniques used in digital image processing.
4. Understand the image restoration techniques and methods used in digital image processing.
5. Understand the Color image and Morphological Operations used in digital image processing.

MODULE – 1

Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition. Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

MODULE – 2

Image Enhancement in the Spatial Domain: Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

MODULE – 3

Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-DDFT, Filtering in the Frequency

Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

MODULE – 4

Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position- Invariant degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

MODULE – 5

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing. The Hit-or-Miss Transforms. Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing.

Course Outcomes:

After studying this course the student should be able to:

- Describe image formation, components of image processing system, Sampling, quantization and some of the relation between pixels.
- Classify image processing techniques in both the spatial domains using various transformations
- Classify image-processing techniques in frequency (Fourier) domains using various transformations.
- Categorizing various noise model and image restoration techniques using spatial and frequency domain filtering.
- Describe various colour image and morphological image processing techniques.

Text Book:

1. Digital Image Processing – Rafael C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.

Reference Books:

1. Digital Image Processing- S. Jayaraman, S. Esakkirajan, T. Veerakumar, Tata Mc Graw Hill, 2014.
2. Fundamentals of Digital Image Processing-A.K.Jain, Pearson 2004.
3. Image Processing analysis and Machine vision with Mind Tap by Milan Sonka and Roger Boile, Cengage Publications, 2018.

Semester	VI	Course Title	Principles of Communication Systems	Course Code	22ECOE655
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS – 03					

Course Objectives:

This course will enable students

1. Understand and appreciate the need of various modulation and spread spectrum techniques.
2. Analyze the properties of basic Modulation techniques and apply them to Digital Communication
3. Apply different types of coding techniques to design the optimum receiver for channels with ISI and AWGN.
4. Design and develop the different types of modulation techniques, equalizer to improve the performance under fading channels for various applications.

MODULE – 1

Digital Modulation Techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature – modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ray modulation techniques, Power spectra, Bandwidth efficiency, M-array modulation formats viewed in the light of the channel capacity theorem, Effect of inter symbol interference, Bit versus symbol error probabilities, Synchronization, Applications.

MODULE – 2

Coding Techniques: Convolutional encoding, Convolutional encoder representation, Formulation of the convolutional decoding problem, Properties of convolutional codes: Distance property of convolutional codes, Systematic and nonsystematic convolutional codes, Performance Bounds for Convolutional codes, Coding gain, Other convolutional decoding algorithms, Sequential decoding, Feedback decoding, Turbo codes.

MODULE – 3

Linear and Adaptive Equalization: Linear equalization, Decision -feedback equalization, Reduced complexity ML detectors, Iterative equalization and decoding - Turbo equalization. Adaptive linear equalizer, adaptive decision feedback equalizer, Recursive least square algorithms for adaptive equalization.

MODULE – 4

Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spread spectrum signals, Time hopping SS, Synchronization of SS systems.

MODULE – 5

Digital Communication through Fading Multipath Channels: Characterization of fading multipath channels, The effect of signal characteristics on the choice of a channel model, Frequency nonselective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel.

Course Outcomes:

After studying this course the student should be able to:

- Explain merits and demerits of different modulation techniques & coding techniques, spread spectrum signals and channel behaviors
- Analyze various modulation, equalization, diversity and coding techniques for communication systems
- Compare performance of different types of modulation on different wireless application fading channels.
- Design and Demonstrate various modulation/coding equalization techniques and measure their performance.

Text Book:

1. Simon Haykin, “Digital Communication”, Reprint, Wiley, 2013, ISBN: 0471647357, 9780471647355.
2. John G. Proakis, “Digital Communications”, McGraw Hill, 5th Edition,

2008.

Reference Books:

1. Bernard Sklar, “Digital Communications - Fundamentals and Applications”, Pearson Education (Asia) Pvt. Ltd, 2nd Edition, 2014, ISBN: 1292026065, 9781292026060.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005

Semester	VI	Course Title	Advance Communication System Lab	Course Code	22ECL66
Teaching Period	24Hours	L – T – P – TL*	0 – 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 01					

Course Objectives:

This course will enable students

1. Design and demonstrate the digital modulation techniques
2. Demonstrate and measure the wave propagation in micro strip antennas
3. Characteristics of micro strip devices and measurement of its parameters.
4. Model an optical communication system and study its characteristics.
5. Simulate the digital communication concepts, compute, and display various Parameters along with plots/figures.

LABORATORY EXPERIMENTS

1. Time Division Multiplexing and De-multiplexing of two band limited signals.
2. ASK generation and detection
3. FSK generation and detection
4. PSK generation and detection
5. Determination of :
 - a. Coupling and isolation characteristics of micro strip directional coupler.
 - b. Resonance characteristics of micro strip ring resonator and computation of die-lectric constant of the substrate.
 - c. Power division and isolation of micro strip power divider.
6. Measurement of propagation loss, bending loss and numerical aperture of an optical fiber.
7. Simulate NRZ, RZ, half-sinusoid and raised cosine pulses and generate eye diagram for binary polar signaling.
8. Simulate the QPSK transmitter and receiver. Plot the signals.

Course Outcomes:

After studying this course the student should be able to:

- Outline the digital modulation techniques-ASK, FSK and PSK.
- Measure the parameters of micro strip devices-directional coupler, micro strip ring resonator and power divider.
- Construct the experimental setup to find out propagation loss, bending loss and numerical aperture.
- Demonstrate the simulation of types of digital signals - pulse code modulation, QPSK and DPSK.

Semester	VI	Course Title	ARM & ES Lab	Course Code	22ECL67
Teaching Period	24 Hours	L – T – P – TL*	0 – 0 – 2 – 2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS - 01					

Course Objectives:

This course will enable students

1. Choose the suitable instruction sets to multiply two 16 bit binary numbers and to find the sum of 10 numbers.
2. Apply the programming concept of GPIO registers to interact between ARM cortex M3 and programmer.
3. Adopt the keil software tools along with Assembly and C language for Interfacing applications.

LABORATORY EXPERIMENTS

PART – A

1. ALP to multiply two 16 bit binary numbers
2. ALP to find the sum of first 10 integer numbers.

PART – B

1. Display “Hello World” message using Internal UART.
2. Interface and control a DC motor.
3. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
4. Interface a DAC and generate Triangular and Square waveforms.
5. Interface a 4x4 keyboard and display the key code on an LCD.
6. Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.
7. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
8. Interface a simple Switch and display its status through Relay, Buzzer and LED

Course Outcomes:

After studying this course the student should be able to:

- Explain the instruction set of ARM Cortex M3, a 32 bit microcontroller and the software tool required for programming in Assembly and C language.
- Develop the Program ARM Cortex M3 using the various instructions in assembly level language for different applications.
- Develop the program for Interface of external devices and I/O with ARM Cortex M3.
- Develop C language programs and library functions for embedded system applications.

Semester	VII	Course Title	Computer Networks	Course Code	22EC71
Teaching Period	50Hours	L – T – P– TL*	3–1–0–5	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS-04					

Course Objectives:

- Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
- Understand the protocols associated with each layer.
- Learn the different networking architectures and their representations.
- Learn the functions and services associated with each layer.

Module 1

Introduction:

Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. (1.1,1.2, 1.3(1.3.1to 1.3.4 of Text)

Network Models:

Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.(2.1, 2.2, 2.3 of Text) L1,L2

Module 2

Data-link Layer:

Introduction: Nodes and Links, Services, Two Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking. (9.1, 9.2(9.2.1, 9.2.2), 11.1,11.2 of Text)

Media Access Control:

Random Access: ALOHA, CSMA, CSMA/CD, CSMA/ CA.(12.1 of Text) Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control. (13.1, 13.2(13.2.1 to 13.2.5), 15.1 of Text) L1,L2,`L3

Module3

Network Layer:

Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution, Forwarding of IP Packets: Based on destination Address and Label. (18.1, 18.2, 18.4, 18.5.1, 18.5.2 of Text)

Network Layer Protocols:

Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagram. (19.1 of Text).

Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. (20.1, 20.2 of Text) L1,L2, L3.

Module 4

Transport Layer:

Introduction: Transport Layer Services, Connectionless and Connection oriented protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go- Back-N Protocol, Selective repeat protocol. (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4 of Text) Transport-Layer Protocols in the Internet:

User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. (24.2,24.3.1,24.3.2,24.3.3,24.3.4,24.3.5,24.3.6,24.3.7,24.3.8,24.3.9 of Text).

Module 5

Application Layer:

Introduction: providing services, Application- layer paradigms, Standard Client -Server Protocols: World wide web, Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Web Based Mail, Telnet: Local versus remote logging. Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. (25.1, 26.1, 26.2, 26.3, 26.4, 26.6 of Text).

Course Outcomes:

At the end of the course, the students will be able to:

1. Explain the functionalities and components involved in layered network architecture and telephone networks.
2. Illustrate the different services, data link protocols used for noisy and noiseless channels.
3. Analyse the different services, delivery methods, packet formats, connecting devices and protocols used in network layer.
4. Design and develop the different services and protocols used in application layer.

TextBooks:

- Behrouz A Forouzan, “Data Communications and Networking”,5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

Reference Books:

- James J Kurose, Keith W Ross, “Computer Networks”, Pearson Education.

Semester	VII	Course Title	VLSI Design	Course Code	22EC72
Teaching Period	50Hours	L – T – P– TL*	3–1–0–5	Credits	4
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS-04					

Course Objectives:

- Impart knowledge of MOS transistor theory and CMOS technologies
- Impart knowledge on architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology
- Acquire the concepts of subsystem design processes
- Demonstrate the concepts of CMOS testing

Module 1

Introduction:A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (TEXT2)

Fabrication:NMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process], BiCMOS Technology (TEXT1)

Module 2

MOS and BiCMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout.

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance Concept applied to MOS Transistors & Inverters, Area Capacitances of Layers, Standard Unit of Capacitance, Some Area Capacitance Calculations, Delay Unit, Inverter Delays, Driving Large Capacitive Loads,(TEXT1).

Module 3

Scaling of MOS Circuits: Scaling Models & Scaling Factors for Device Parameters

Subsystem Design Processes: Some General considerations, An illustration of Design Processes, Illustration of the Design Processes- Regularity, Design of an ALU Subsystem, The Manchester Carry- chain and Adder Enhancement Techniques (TEXT1)

Module 4

Subsystem Design: Some Architectural Issues, Switch Logic, Gate(restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA), Two phase Clocking, Charge storage, Dynamic Register Element, Dynamic Shift Register (TEXT1).

FPGA Based Systems: Introduction, Basic concepts, Digital design and FPGA's, FPGA based System design, FPGA architecture, Physical design for FPGA's(TEXT3)

Module 5

Memory, Registers and Aspects of system Timing-System Timing Considerations, Some commonly used Storage/Memory elements (TEXT1).

Testing and Verification: Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability (TEXT 2)

Course Outcomes:

At the end of the course, the students will be able to:

- Explain Ideal and Non ideal I-V characteristics, fabrication flow of MOS transistors.
- Design stick and layout diagram of digital circuits.
- Estimate the scaling factors, MOS device parameters & performance of various subsystems.
- Analyze the architectural issues, Clocked sequential circuits and physical design flow of the system.
- Discuss timing consideration of memory elements, verification and testability issues of subsystem.

TextBooks:

- “Basic VLSI Design”-Douglas A. Pucknell & Kamran Eshraghian, PHI3rd Edition (original Edition – 1994).
- “CMOS VLSI Design- A Circuits and Systems Perspective”-Neil H.E.Weste, David Harris, Ayan Banerjee, 3rd Edition, Pearson Education.
- “FPGA Based System Design”-Wayne Wolf, Pearson Education,2004, Technology and Engineering.

Reference Books:

- ”CMOS Digital Integrated Circuits: Analysis and Design”-Sung MoK ang &Yosuf Leblebici, Tata McGraw-Hill, Third Edition.

Professional Elective - VI					
Semester	VII	Course Title	Digital Image Processing	Course Code	22 EC 731
Teaching Period	40 Hours	L - T - P - TL*	2 - 0 - 1 - 4	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS-03					

Course Objectives:

- Understand the fundamentals of digital image processing.
- Understand the image enhancement techniques in spatial domain.
- Understand the image enhancement techniques in frequency domain and also the basics of image Transforms.
- Understand the image restoration techniques and methods used in digital image processing.
- Understand the Color image and Morphological Operations used in digital image processing.

Module 1

Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition. Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Module 2

Image Enhancement in the Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters,

Module 3

Frequency Domain and Basics of Image Transforms: Properties of the 2-DDFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Need for Image Transforms, Classification, Unitary Transform.

Module 4

Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position- Invariant degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering,

Module 5

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing. The Hit-or-Miss Transforms.

Color Image Processing: Color Fundamentals, Color image Representation in MATLAB, Color Models, Pseudo color Image Processing.

Course Outcomes:

- Describe image pixel relation, enhancement techniques, Transform, restoration, color and morphological Image processing techniques.
- Apply the image processing techniques to obtain the enhanced image, Image transforms, restoration and morphological image processing techniques.
- Analyze the different image enhancement techniques in spatial and domain, Image transforms and color image processing.

Text Books:

- “Digital Image Processing” – Rafael C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.

Reference Books:

- “Digital Image Processing”- S. Jayaraman, S. Esakkirajan, T. Veerakumar, Tata McGrawHill 2014.
- “Fundamentals of Digital Image Processing”-A.K.Jain, Pearson 2004.
- “Image Processing analysis and Machine vision with Mind Tap” by Milan Sonka and RogerBoile, Cengage Publications, 2018.

Professional Elective - III					
Semester	VII	Course Title	Power Electronics	Course Code	22EC732
Teaching Period	40Hours	L – T – P– TL*	2–1–0–4	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS-04					

Course Objectives:

- Understand the construction and working of various power devices.
- Study and analysis of thyristor circuits with different triggering conditions.
- Learn the applications of power devices in controlled rectifiers, converters and inverters.
- Study of power electronics circuits under various load conditions.

Module 1

Introduction: Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches.

Power Diodes: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes, Freewheeling diodes with RL load.

Diode Rectifiers: Introduction, Diode Circuits with DC Source connected to R and RL load, Single- Phase Full-Wave Rectifiers with R load , Single-Phase Full-Wave Rectifier with RL Load.

Module 2

Power Transistors: Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, IGBTs, MOSFET Gate Drive, BJT Base Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers.

Module 3

Thyristors: Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn- On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dt Protection, dv/dt Protection.

Module 4

Controlled Rectifiers: Introduction, Single phase half wave circuit with RL Load, Single phase half wave circuit with RL Load and Freewheeling Diode, Single phase half wave circuit with RLE Load, Single-Phase Full Converters with RLE Load.

AC Voltage Controllers: Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads.

Module 5

DC-DC Converters: Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.

DC-AC Converters: Introduction, principle of operation single phase bridge inverters, three phase bridge inverters, voltage control of single phase inverters.

Course Outcomes:

At the end of the course, the students will be able:

- To discuss an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
- To distinguish the techniques for design and analysis of single-phase rectifier circuits.
- To explain different power transistors, their steady state and switching characteristics and limitations.
- To analyse different types of Thyristors, their gate characteristics and gate control requirements.
- To design and analyse various types of converters.

TextBook:

- “Power Electronics: Circuits Devices and Applications”, Mohammad H Rashid, Pearson 4th Edition, 2014.

ReferenceBooks:

- “Power Electronics” P.S. Bimbhra, Khanna Publishers, 5th Edition, 2012.
- “Power Electronics: Converters, Applications and Design”, Ned Mohan et al, Wiley 3rd Edition, 2014.
- “Power Electronics”, Daniel W Hart, McGraw Hill, 1st Edition, 2011.
- “Elements of Power Electronics”, Philip T Krein, Oxford Indian Edition, 2008.

Professional Elective - III					
Semester	VII	Course Title	Analog and Mixed Mode VLSI Design	Course Code	22 EC 733
Teaching Period	50 Hours	L – T – P – TL*	3 – 1 – 0 – 5	Credits	4
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS-04					

Course Objectives:

- Describe basic physics and operation of MOS devices.
- Exemplify single-stage and differential amplifiers and current mirrors
- Describe operational amplifiers
- Learn the design of phase-locked-loops
- Know the role of Data converters in an ever-increasing digital world.

Module 1

Basic MOS Device Physics: General considerations, MOSI/V Characteristics, second order effects, MOS device models.

Single stage Amplifier: Basic Concepts, Common Source stage.

Module 2

Single stage Amplifier: Source follower, common-gate stage, Cascode Stage, choice of device models.

Differential Amplifiers: Single ended and differential operation, Basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Module 3

Passive and Active Current Mirrors: Basic current mirrors, Cascode Current mirrors, Active Current mirrors.

Operational Amplifiers (part-1): General Considerations, One Stage OP-Amp, Two Stage OP-Amp, Gain boosting.

Module 4

Operational Amplifiers (part-2): Common Mode Feedback, Slew rate, Power Supply Rejection.

Phase Locked Loops: Simple PLL, Charge pump PLLs, Non-ideal effects in PLLs, Delay-Locked Loops, Applications.

Module 5

Data Converter Architectures: DAC & ADC Specifications, Current Steering DAC, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.

Course Outcomes:

At the end of the course, the students will be able to:

- Use efficient analytical tools for quantifying the behavior of basic circuits by inspection.
- Design high-performance, stable operational amplifiers with the tradeoffs between speed, precision and power dissipation.
- Analyze the behavior of phase-locked-loops for various applications.
- Evaluate the critical parameters of VLSI circuits', Digital / discrete time domain and more sophisticated converters.

Text Books:

- Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH, 2007.
- R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", Second Edition, Wiley.

Reference Books:

- Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", Second Edition, Oxford University Press.

Semester	VII	Course Title	Robotics and Automation	Course Code	22 EC 734
Teaching Period	40Hours	L –T –P–TL*	2–1–0 –4	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS- 04					

Course Objectives:

- To identify potential areas for automation and justify need for automation.
- To select suitable major control components required to automate a process or an activity
- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the control of robots for some specific applications.

Module 1

Introduction to automation: Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data.

Module 2

Automated production lines: Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems, fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies.

Module 3

Industrial Robotics: Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robots, various generations of robots, degrees of freedom – Asimov’s laws of robotics, dynamic stabilization of robots.

Module 4

Spatial descriptions and transformations: Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison. Position sensors –potentiometers, resolvers, encoders –Velocity sensors, Tactile sensors, Proximity sensors.

Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation -D-H notation, Forward and inverse kinematics.

Module 5

Robot programming: Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications.

Course Outcomes:

- Discuss the basics of automation, production line and industrial robotics.
- Design and develop suitable automation hardware for the given application.
- Analyze and implement appropriate modeling and simulation tool for the given manufacturing Application.
- Explain the basic principles of Robotic technology, configurations, control and Programming of Robots.
- Develop and apply the program for various functional tasks.

Text Books:

- “Computer Integrated Manufacturing”, Mikell P. Groover, Pearson, 3rd edition, 2009.
- “Introduction to robotics mechanics and control” John J. Craig Pearson, 3rd edition, 2009.

ReferenceBooks:

- “Robotics for Engineers”, Yoram Koren, McGraw Hill International, 1st edition, 1985.
- “Industrial Robotics” Weiss, Nagel, McGraw Hill International, 2nd edition,2012
- “Robotic Engineering - An Integrated approach” Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
- “Computer Based Industrial Control”, Krishna Kant, EEE-PHI, 2nd edition, 2010.
- “An Introduction to Automated Process Planning System”, Tiess Chiu Chang & Richard A. Wysk.

Professional Elective-III					
Semester	VII	Course Title	Multimedia Communication	Course Code	22EC735
Teaching Period	40Hours	L – T – P– TL*	2–1–0–4	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS-03					

Course Objectives:

- Learn the fundamentals of digital image processing.
- Acquire the knowledge in image enhancement techniques in spatial domain.
- Understand the image enhancement techniques in frequency domain and also the basics of image Transforms.
- Understand the image restoration techniques and methods used in digital image processing.
- Understand the Color image and Morphological Operations used in digital image Processing.

Module 1

Multimedia Communications: Multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.

Module 2

Video compression: Video compression principles, video compression standards: H.261, H.263, MPEG 1, MPEG 2, and MPEG 4. DivX, Flash Video, Avi, WMV.

Module 3

Standards and Protocols: JPEG 2000 compression standard — development process, features, architecture, bit stream, MPEG — 21 multimedia framework, Protocols - RTP, RTCP, RTSP, RSVP,DVMRP.

Module 4

Multimedia Entertainment Networks: Introduction, Cable TV networks, Satellite TV networks, Terrestrial TV networks. High speed PSTN access Technologies.

Module 5

Digital Video Broadcasting: DVB Inter-operabilities, DVB System, Baseband processing, Digital Television, Services over IP-based networks, Services, Authentication, Authorization. DVB and Internet: IP Multicast, Audio/Video streaming.

Course Outcomes:

After successful completion of this course the student will be able to:

- Explain multimedia information representation, networks and compression techniques.
- Analyze the applications like interpersonal communication, interactive communication over the internet and entertainment networks.
- Design various coding methods and compression techniques.
- Analyze and distinguish the various broadcasting systems.

TextBooks:

- “Multimedia Communications”, Fred Halsall, 2001, Pearson education, ISBN: 978-81-317- 0994-8.
- “Introduction to Multimedia Communications”, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, 2014, Wiley, ISBN 13 978-0-471-46742-7.

ReferenceBooks:

- “Multimedia Communication Systems”, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic 2004, Pearson education.
- “Fundamentals of Wireless Sensor Networks Theory and Practice”, Walteneus Dargie and Christin Poellabauer, 1st Edition, John Wiley, 2010.

Semester	VII	Course Title	Embedded System	Course Code	22ECOET41
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS – 03					

Course Objectives:

- Provide a general overview of Embedded Systems
- Show current statistics of Embedded Systems
- Design, code, compile, and test real-time software
- Integrate a fully functional system including hardware and software.

Module -1

Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.

Module -2

Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols-parallel communication internet using ISA, PCI, PCI-X and advanced buses, Internet enabled systemsnetwork protocols, Wireless and mobile system protocols.

Module -3

Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming.

Module -4

Inter process communication and synchronization of processes, Threads and tasks: Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Interprocess communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.

Module -5

Real-time operating systems: OS Services, Process management, Timer functions, Event functions, Memory management, Device, file and IO subsystems management, Interrupt routines in RTOS environment and handling of interrupt source calls, Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software.

Course Outcomes:

At the end of the course, students will be able to

- Distinguish the characteristics of embedded computer systems.
- Examine the various vulnerabilities of embedded computer systems.
- Design and develop modules using RTOS.
- Implement RPC, threads and tasks

Text Book:

1. Raj Kamal, “Embedded Systems: Architecture, Programming, and Design” 2nd / 3rd edition , Tata McGraw hill-2013.

Reference Books:

1. Marilyn Wolf, “Computer as Components, Principles of Embedded Computing System Design” 3rd edition, Elsevier-2014.

Semester	VII	Course Title	ARTIFICIAL NEURAL NETWORK	Course Code	22ECOE742
Teaching Period	40Hours	L – T – P– TL*	2–1–0–4	Credits	3
CIE*	50Marks	SEE*	50Marks	Total	100Marks
CREDITS-03					

Module 1

Introduction:

Biological Neuron- Artificial Neural Model- Types of activation functions-

Architecture:

Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks.

Learning:

Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.

Module 2

Supervised Learning:

Perceptron learning and Non Separable sets, a.-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, JL-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Back propagation Learning Algorithm, Practical consideration of BP algorithm.

Module 3

Support Vector Machines and Radial Basis Function:

Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

Module 4

Support Vector Machines and Radial Basis Function:

Learning from Examples, Statistical Learning Theory, Support Vector

Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

Module 5

Self-organization Feature Map:

Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self organization Feature Maps, Application of SOM, Growing Neural Gas.

Course Outcomes:

At the end of the course, the students will be able to:

- Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.
- Understand the concepts and techniques of neural networks through the study of important neural network models.
- Evaluate whether neural networks are appropriate to a particular application.
- Apply neural networks to particular application.
- Analyze the steps needed to improve performance of the selected neural network.

Text Book:

- “Neural Networks A Classroom Approach”, Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Reference Book:

- “Introduction to Artificial Neural Systems”, J.M. Zurada, Jaico Publications, 1994.
- “Artificial Neural Networks”, B. Yegnanarayana, PHI, New Delhi 1998.

Semester	VII	Course Title	BASIC VLSI DESIGN	Course Code	22ECOE743
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 3	Credits	3
CIE*	40 Marks	SEE*	60 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

- Learn and Understand IC Fabrication process steps required for various MOS circuits
- Understand and Experience VLSI Design Flow
- Learn Transistor-Level CMOS Logic Design
- Understand VLSI Fabrication and Experience CMOS Physical Design
- Learn to Analyze Gate Function and Timing Characteristics

Module 1

Introduction: Introduction to MOS Technology –MOS, PMOS, NMOS, CMOS and BiCMOS technologies, fabrication fundamentals: Oxidation, Lithography, Diffusion, Ion implantation, Metallization and Encapsulation. Basic Electrical Properties: Basic Electrical Properties of MOS, CMOS and BiCMOS Circuits, IDS-VDS relationships, MOS transistor threshold Voltage, gm, gds, figure of merit ω_0 , Pass transistor, NMOS inverter, Various pull -ups, Determination of pull-up to pulldown ratio(Z_{pu}/ Z_{pd}), CMOS Inverter analysis and design, BiCMOS inverters, Latch-up in CMOS circuits.

Module 2

VLSI Circuit Design Processes:VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layouts, Lambda based design rules, Contact cuts , CMOS Lambda based design rules,Layout Diagrams for logic gates, Transistor structures, wires and vias, Scaling ofMOS circuits-Scaling models, scaling factors, scaling factors for device parameters, Limitations of Scaling. Module

Gate Level Design and Layout: Architectural issues, Switch logic networks: Gate logic, Alternate gate circuit: Pseudo-NMOS Dynamic CMOS logic. Basic circuit concepts, Sheet Resistance R_S and its concept to MOS, Area Capacitance Units, Calculations, The delay unit T, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out, Choice of layers.

Module 4

Subsystem Design: Subsystem Design, Shifters, Adders, ALUs, Multipliers: Array multiplier, Serial Parallel multiplier, Parity generator, Comparators, Zero/One Detectors, Up/DownCounter, Memory
elements: SRAM, DRAM, ROM, Serial Access Memories.

Module 5

Semiconductor Integrated Circuit Design: PLDs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Programmable Logic Array Design Approach.

Course Outcomes

- Explain the basic fabrication process of MOS transistors, study CMOS inverter circuits, basic circuit concepts such as Sheet Resistance, Area Capacitance and Delay calculation, Field programmable gate arrays and realization techniques, CPLDs and FPGAs for implementing the various logic functions.
- Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality.
- Analyze the performance of CMOS Inverter circuits.
- Compare various Scaling models and understand the effect of scaling on device parameters.

Text Books

1. “Essentials of VLSI circuits and systems”, Eshraghian Douglas and A. Pucknell, PHI, 2005 Edition.
2. “Modern VLSI Design”, Wayne Wolf, 3rd Edition, Pearson Education, 1997.

Reference Books

1. “CMOS logic circuit Design”, John .P. Uyemura, Springer, 2007.
2. “CMOS VLSI Design –A Circuits and Systems Perspective”, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd edition, Pearson, 2009.

Semester	VII	Course Title	Mobile Communication	Course Code	22ECO744
Teaching Period	40 Hours	L – T – P – TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

This course will enable students to

- Understand the requirements for Long term evolution.
- Explore the architectural view of LTE network.
- Identify the requirements and challenges in establishing a 5G network.
- Acquire the knowledge to Categorize the various applications of 5G network.

Module 1

Introduction: Significance and scope of wireless technologies, Importance in the economic growth of the nation. Career perspectives. Impact on national economy, state of art and future directions in mobile communication.

Introduction to LTE: The Context for the Long Term Evolution of UMTS, Requirements and Targets for the Long Term Evolution, Technologies for the Long Term Evolution.

Module 2

Network Architecture: Introduction, Overall Architectural Overview, Protocol Architecture, Quality of Service and EPS Bearers, The E-UTRAN Network Interfaces: S1 Interface, The E- UTRAN Network Interfaces: X2 Interface.

Module 3

Drivers for 5G: The ‘Pervasive Connected World: Introduction, Historical Trend of Wireless Communications, Historical Trend of Wireless Communications, 5G Roadmap, 10 Pillars of 5G, 5G Architecture.

Module 4

The 5G Internet: Introduction, Internet of Things and Context-Awareness, Networking Reconfiguration and Virtualization Support, Mobility, Quality of Service Control, Emerging Approach for Resource Over-Provisioning.

Module 5

Small Cells for 5G Mobile Networks:

Introduction, What are Small Cells, Capacity Limits and Achievable Gains with Densification, Mobile Data Demand, Demand vs Capacity, Small-Cell Challenges, Conclusions and Future Directions.

Co-operation for Next Generation Wireless Networks: Cooperative Diversity and Relaying Strategies, PHY Layer Impact on MAC Protocol Analysis.

Course Outcomes:

After studying this course, students will be able to:

- Describe the basics of cellular networks and its applications, network architecture and 5G networks
- Apply the characteristics/protocols of wireless communication to establish the LTE/5G communication channel.
- Examine the requirements in establishing the LTE/5G communication Network.
- Appraise the challenges in establishing 5G network.

Text Books:

1. Stefania Sesia, Issam Toufik, Matthew Baker, “LTE – The UMTS Long Term Evolution From Theory to Practice”, 2nd Edition, Wiley.
2. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, 2015, Wiley.

Reference Book:

1. Ramjee Prasad , “5G Outlook – Innovations and Applications”, River Publishers Series in Communications.

Semester	VII	Course Title	Nano Electronics	Course Code	22ECOC745
Teaching Period	40 Hours	L – T – P– TL*	2 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

This course will enable students to:

- Understand the fundamentals, fabrication technologies and applications of Nano scale structures
- Learn about physical background and applications of Nano electronics
- Know about resonant-tunneling devices, transistors and single-electron transfer devices.

Module 1

Introduction: Overview of nanoscience and engineering. Development milestones in micro fabrication and electronic industry, Moore’s law and miniaturization & Classification of Nanostructures.

Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale.

Module 2

Fabrication methods: Top down processes, Bottom up processes methods for tinplating the growth of nanomaterials, ordering of Nano systems.

Fabrication techniques: Requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, colloidal quantum dots, self-assembly techniques.

Module 3

Molecular Nano electronics: Electronic and optoelectronic properties of molecular materials - Electrodes & contacts – functions – molecular

electronic devices - elementary circuits using organic molecules Organic materials based rectifying diode switches– TFTs- OLEDs- OTFTs – logic switches.

Memory devices and sensors: Ferroelectric random access memory (RAM), Magnetic RAMS-Field Sensors – Multi Ferro electric sensors- Spintronic Biosensors.

Module 4

MOSFET: Principles of operation of MOSFET, concept of top of the barrier, Short channel effects, Quantum effects in MOSFET - Coupled Poisson-Schrodinger equations and iterative solutions, quantization in MOSFET channel, quantum capacitance, Tunneling, One dimensional barrier transmission problem, Gate oxide tunneling, Direct source to drain tunneling, Band-to-band tunneling.

Module 5

Nano electronic devices: Introduction to tunneling, Magnetic tunnel junctions, Tunneling spin polarization, Giant tunneling Mgo, Resonant-tunneling diodes, Field-effect transistors, Single-electron-transfer Devices.

Course Outcomes:

After studying this course, Students will be able to

- Understand the basics of nanoscience, molecular structure, principle of operation & Nano electronic devices.
- Interpret the properties of molecular non material's, fabrication process, memory devices and sensors.
- Analyse and examine the various fabrication methods, elementary circuits developed based on diode switches and tunneling effects in nano devices.
- Design of combinational circuits using discrete gates, MOSFET & various tunneling based diodes and transistors.

TEXT BOOKS:

1. Robert Kelsall, Ian Hamley and Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, "Introduction to Nanotechnology", John Wiley, Copyright 2006, Reprint 2011.

3. V. Mitin, V. Kochelap, M. Stroschio, "Introduction to Nanoelectronics", Cambridge University Press, 2008.

Reference Book:

1. D. J. Griffiths, "Introduction of Quantum Mechanics", Prentice Hall.

Semester	VII	Course Title	VLSI Lab	Course Code	22ECL76
Teaching Period	24 Hours	L – T – P– TL*	0–0–2 –2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks

Course Objectives:

- Design, model, simulate and verify CMOS digital circuits.
- Design layouts and perform physical verification of CMOS digital circuits.
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
- Perform RTL-GDSII flow and understand the stages in ASIC design

Experiments can be conducted using any of the following or equivalent design tools:

Cadence/Synopsis/Mentor Graphics/ Micro wind

Laboratory Experiments

PART - A ANALOG DESIGN

Use any VLSI design tools to carry out the experiments, use library files and technology files below 180 nm.

1. a) Capture the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of inverter with $W_n = W_p$, $W_n = 2W_p$, $W_n = W_p/2$ and length at selected technology. Carry out the following:
 - a. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and time period of 20ns and plot the input voltage and output voltage of designed inverter?
 - b. From the simulation results compute t_{pHL} , t_{pLH} and t_d for all three geometrical settings of width?
 - c. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter?
1. b) Draw layout of inverter with $W_p/W_n = 40/20$, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

2. a) Capture the schematic of 2-input CMOS NAND gate having similar delay as that of CMOS inverter computed in experiment 1. Verify the functionality of NAND gate and also find out the delay t_d for all four possible combinations of input vectors. Table the results. Increase the drive strength to 2X and 4X and tabulate the results.
- 2.b) Draw layout of NAND with $W_p/W_n = 40/20$, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
- 3.a) Capture schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response and AC response? Measures the Unity Gain Bandwidth (UGB), amplification factor by varying transistor geometries, study the impact of variation in width to UGB.
3. b) Draw layout of common source amplifier, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
4. a) Capture schematic of two-stage operational amplifier and measure the following:
 - a. UGB.
 - b. dB bandwidth.
 - c. Gain margin and phase margin with and without coupling capacitance.
 - d. Use the op-amp in the inverting and non-inverting configuration and verify its functionality.
 - e. Study the UGB, 3dB bandwidth, gain and power requirement in op-amp by varying the stage wise transistor geometries and record the observations.
4. b) Draw layout of two-stage operational amplifier with minimum transistor width set to 300 (in 180/90/45 nm technology), choose appropriate transistor geometries as per the results obtained in 4.a. Use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

PART - B DIGITAL DESIGN

Carry out the experiments using semicustom design flow or ASIC design flow, use technology library 180/90/45nm and below.

Note: The experiments can also be carried out using FPGA design flow, it is required to set appropriate constraints in FPGA advanced synthesis options.

1. Write verilog code for 4-bit up/down asynchronous reset counter and carry out the following:
 - a. Verify the functionality using test bench.
 - b. Synthesize the design by setting area and timing constraint. Obtain the gate level netlist, find the critical path and maximum frequency of operation. Record the area requirement in terms of number of cells required and properties of each cell in terms of driving strength, power and area requirement.
 - c. Perform the above for 32-bit up/down counter and identify the critical path, delay of critical path, and maximum frequency of operation, total number of cells required and total area.
2. Write verilog code for 4-bit adder and verify its functionality using test bench. Synthesize the design by setting proper constraints and obtain the net list. From the report generated identify critical path, maximum delay, total number of cells, power requirement and total area required. Change the constraints and obtain optimum synthesis results.
3. Write verilog code for UART and carry out the following:
 - a. Perform functional verification using test bench.
 - b. Synthesize the design targeting suitable library and by setting area and timing constraints.
 - c. For various constrains set, tabulate the area, power and delay for the synthesized netlist.
 - d. Identify the critical path and set the constraints to obtain optimum gate level netlist with suitable constraints.
4. Write verilog code for 32-bit ALU supporting four logical and four arithmetic operations, use case statement and if statement for ALU behavioral modeling.
 - a. Perform functional verification using test bench.
 - b. Synthesize the design targeting suitable library by setting area and timing constraints.

- c. For various constraints set, tabulate the area, power and delay for the synthesized netlist.
 - d. Identify the critical path and set the constraints to obtain optimum gate level netlist with suitable constraints.
Compare the synthesis results of ALU modeled using IF and CASE statements.
5. Write verilog code for Latch and Flip-flop, Synthesize the design and compare the synthesis report (D, SR,T,JK).
 6. For the synthesized netlist carry out the following for any two above experiments:
 - a. Floor planning (automatic), identify the placement of pads.
 - b. Placement and Routing, record the parameters such as no. of layers used for routing, flip method for placement of standard cells, placement of standard cells, routes of power and ground, and routing of standard cells.
 - c. Physical verification and record the LVS and DRC reports.
 - d. Perform Back annotation and verify the functionality of the design.
 - e. Generate GDSII and record the number of masks and its color composition.

Course outcomes:

- Design and simulate combinational and sequential digital circuits using Verilog HDL.
- Understand the Synthesis process of digital circuits using EDA tool.
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level net list.
- Design and simulate basic CMOS circuits like inverter, common source amplifier and differential amplifiers.
- Perform RTL-GDSII flow and understand the stages in ASIC design

Semester	VII	Course Title	Computer Networks Lab	Course Code	22 ECL 75
Teaching Period	24 Hours	L – T – P– TL*	0–0–2 –2	Credits	1
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 01					

Course Objectives:

- To understand the working principle of various communication protocols.
- To understand the network simulator environment and visualize a network topology and observe its performance

Laboratory Experiments

1. Implement three nodes point-to-point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
2. Implement the data link layer framing methods such as character-stuffing and bit stuffing.
3. Write a program to compute CRC code for the polynomials CRC-12, CRC-16 and CRC CCIP
4. Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.
5. Implement Dijkstra’s algorithm to compute the shortest path through a network
6. Implement data encryption and data decryption
7. Simulate the network with five nodes n0, n1, n2, n3, n4, forming a star topology. The noden4 is at the centre. Node n0 is a TCP source, which transmits packets to node n3 (a TCPSink) through the node n4. Node n1 is another traffic source, and sends UDP packets to noden2 through n4. The duration of the simulation time is 10 seconds.’
8. Simulate to study transmission of packets over Ethernet LAN and determine the number of packets drop at destination

Course Outcomes

- Implement data link layer framing methods.
- Analyze error detection and error correction codes.
- Implement and analyze routing and congestion issues in network design.
- Implement Encoding and Decoding techniques used in presentation layer. To be able to work with different network tools

Semester	VIII	Course Title	Wireless Communication and Fiber Optics	Course Code	22 EC 81
Teaching Period	40 Hours	L – T – P –TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks
CREDITS- 03					

Course Objectives:

This course will enable students to

- Understand the basic concepts of propagation over wireless channels from a physics standpoint.
- Acquire the knowledge about Application of Communication theory both Physical and networking for GSM systems that handle mobile telephony.
- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.

Module 1

Mobile Radio Propagation:

Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms – Reflection (Ground Reflection) , Diffraction, Scattering, Practical Link Budget. (Text 1 - Chapter 4).

Fading and Multipath – Broadband wireless channel, Delay Spread and Coherence Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance. (Text 1 – 2.4) Statistical Channel Model of a Broadband Fading Channel. (Text 1 – 2.5.1)

The Cellular Concept – Cellular Concept, Analysis of Cellular Systems, Sectoring. (Text 1- 2.3)

Module 2

GSM and TDMA Technology:

GSM System overview – Introduction, GSM Network and System Architecture, GSM Channel Concept.

GSM System Operations – GSM Identities, System Operations –Traffic cases, GSM Infrastructure Communications (Um Interface) (Text 2 - Chapter 5).

Module 3

Optical fiber Communications:

Historical development, The general system, Advantages of optical fiber communication, Optical fiber waveguides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers. (Text 3).

Module 4

Transmission characteristics of optical fiber:

Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber.

Optical Fiber Connectors:

Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers. (Text 3).

Module 5

Optical sources: Energy Bands, Direct and Indirect Bandgaps, Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant frequencies, Laser Diode structures and Radiation Patterns: Single mode lasers.

Photodetectors: Physical principles of Photo diodes, Photo detector noise, Detector response time.

Optical Receiver: Optical Receiver Operation: Error sources, Front End Amplifiers, Receiver sensitivity, Quantum Limit. (Text 4).

Course Outcomes:

After studying this course, Students will be able to

- Explain the propagation mechanisms like Reflection, Diffraction, Scattering in wireless channels.
- Design, Develop and implement the schemes for idle mode, call set up, call progress handling and call tear down in a GSM cellular network.

- Classify and Analyze the working of optical fiber based on different modes of signal propagation.
- Describe the constructional features and characteristics of optical sources, detectors, transmission line and its losses in communication networks.

Text Books:

1. “Fundamentals of LTE” Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Pearson education (Formerly Prentice Hall, Communications Engg and Emerging Technologies), ISBN-13: 978-0-13-703311-9.
2. “Introduction to Wireless Telecommunications Systems and Networks”, Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.
3. “Optical Fiber Communications, Principles and Practice”, John M Senior, 3rd Edition Pearson Education, 2010, ISBN:978-81-317-3266-3
4. “Optical Fiber Communication”, Gerd Keiser, 5th Edition, McGraw Hill Education(India) Private Limited, 2015. ISBN: 1-25-900687-5.

Reference Books:

1. “Wireless Communications: Principles and Practice” Theodore Rappaport, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0- 13-042232-0.
2. “Fiber Optic Communication”, Joseph C Palais, Pearson Education, 2005, ISBN:0130085103

Semester	VIII	Course Title	DSP Algorithms and Architecture	Course Code	22EC821
Teaching Period	40 Hours	L – T – P –TL*	3 – 1 – 0 – 4	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks

Course objectives:

This course will enable the students to

- Understand the concepts of digital signal processing techniques.
- Understand the computational building blocks of DSP processors and its speed issues.
- Understand the various addressing modes, peripherals, interrupts and pipelining structure of the TMS320C54xx processor.
- Learn how to interface the external devices to the TMS320C54xx processor in various modes.
- Understand DSP algorithms and applications with their implementation using TMS320C54xx processor.

Module 1

Introduction to Digital Signal Processing: Introduction, A Digital Signal–Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.

Module 2

Architectures for Programmable Digital Signal – Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

Module 3

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal processing Devices, Data Addressing Modes of TMS320C54XX, Memory Space of TMS320C54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54xx Processor.

Module 4

Implementation of Basic DSP Algorithms: Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case).

Implementation of FFT Algorithms: Introduction, an FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index.

Module 5

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA).

Course outcomes:

After studying this course, Students will be able to

- Explain the knowledge & concepts of digital signal processing techniques for various applications.
- Apply the knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor for various applications.
- Develop assembly language programs to implement FIR, IIR filters and FFT algorithms.
- Design, build and investigate the different Applications of Programmable DSP devices.

Text Book:

“Digital Signal Processing”, Avatar Singh and S. Srinivasan, Thomson Learning, 2004.

Reference Books:

1. “Digital Signal Processing: A practical approach”, Ifeachor E. C., Jervis B. W Pearson- Education, PHI, 2002.
2. “Digital Signal Processors”, B Venkataramani and M Bhaskar, TMH, 2nd, 2010.
3. “Architectures for Digital Signal Processing”, Peter Pirsch, John Wiley, 2008.

Semester	VIII	Course Title	ASIC Design	Course Code	22EC822
Teaching Period	40 Hours	L – T – P– TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks

Course Objectives:

This course will enable students to:

- Acquire the basics of ASIC methodologies and programmable logic cells to implement different functions on IC.
- Learn about the back-end physical design flow, including partitioning, floor-planning, placement, and routing.
- Gain sufficient theoretical knowledge on FPGA & ASICS and to design them.

Module 1

Introduction to ASICs: Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries.

CMOS Logic: Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding).

Module 2

ASIC Library Design: Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi stage cells, Optimum delay and number of stages, library cell design.

Programmable ASIC Logic Cells- MUX as Boolean function generators, Acted ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Xilinx LCA: XC3000 CLB, Altera FLEX and MAX.

Module 3

Low-level design entry, Schematic entry: Hierarchical design, The cell library, Names, Schematic Icons & Symbols, Nets, Schematic Entry for ASICs, Connections, vectored instances & buses, Edit in place, attributes, Netlist screener.

ASIC Construction: Physical Design, CAD Tools System partitioning, Estimating ASIC size.

Module 4

Floor planning and placement: Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition.

Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow.

Module 5

Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Detailed Routing: Goals and objectives, Measurement of Channel Density, Left-Edge Algorithm, Area-Routing Algorithms, Multilevel routing.

Course Outcomes:

After studying this course, Students will be able to

- Describe the concepts of ASIC design methodology, data path elements, and logical effort and FPGA architectures.
- Analyze the design of FPGAs and ASICs suitable for specific tasks, perform design entry and explain the physical design flow.
- Design data path elements for ASIC cell libraries and compute optimum path delay.
- Understand the floor plan including partition and global routing.

Text Book:

Michael John Sebastian Smith, “Application - Specific Integrated Circuits” Addison- Wesley Professional, 2005.

Reference Books:

1. Neil H.E. Weste, David Harris, and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, 3rd edition, Addison Wesley/ Pearson education, 2011
2. Vikram Arkalgud Chandra setty, “VLSI Design: A Practical Guide for FPGA and ASIC Implementations”, Springer, 2011, ISBN:978-1-4614-1119-2.
3. Rakesh Chadha, Bhasker J., “An ASIC Low Power Primer”, Springer, ISBN: 978-1- 4614-4270-7.

Semester	VIII	Course Title	Network Security	Course Code	22EC823
Teaching Period	40 Hours	L – T – P– TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks

Course Objectives:

This course will enable students to.

- Explain the concepts of Cyber security.
- Illustrate key management issues and solutions.
- Familiarize with Cryptography and very essential algorithms.
- Understand and Introduce cyber Law and ethics to be followed.

Module 1

Introduction: Cyber Attacks, Defence Strategies and Techniques, Guiding Principles, Mathematical Background for Cryptography - Modulo Arithmetic's, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem. Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret Key.

Module 2

Public Key Cryptography and RSA: RSA& Its Operations, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS). Cryptographic Hash: Introduction, Properties, Construction, Applications and Performance, The Birthday Attack.

Discrete Logarithm and its Applications: Introduction, Diffie-Hellman Key Exchange, Other Applications.

Module 3

Key Management: Introduction, Digital Certificates, Public Key Infrastructure, Identity-based Encryption, Authentication-I - One way Authentication, Mutual Authentication, Dictionary Attacks, Authentication – II – Centralised Authentication.

Security at the Transport Layer: Introduction, SSL Handshake Protocol, SSL Record Layer Protocol, OpenSSL.

Module 4

IEEE 802.11 Wireless LAN Security: Background, Authentication, Confidentiality and Integrity, Viruses, Worms, and Other Malware.

Firewalls: Basics, Practical Issues, Intrusion Prevention and Detection - Introduction, Prevention Versus Detection, Types of Intrusion Detection Systems, DDoS Attacks Prevention/Detection.

Module 5

IT act aim and objectives: Scope of the act, Major Concepts, Important provisions, Attribution, acknowledgement, and dispatch of electronic records, Secure electronic records and secure digital signatures. Regulation of certifying authorities: Appointment of Controller and Other officers, Digital Signature Certificates, Duties of Subscribers, Penalties and adjudication.

Course Outcomes:

After studying this course, Students will be able to

- Discuss the various types of cyber-attacks, cryptography and the cyber securities acts.
- Examine the cryptographically structure, key management process and security methods.
- Design and develop cryptography algorithms, security management for intrusion detection and security with digital signature certificates.

Text Book:

Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition.

Reference Book:

1. Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-GrawHill, 3rd Edition, 2015
2. Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition .
3. Cyber Law simplified- VivekSood, Mc-GrawHill, 11th reprint , 2013
4. Cyber security and Cyber Laws, Alfred Basta, Nadine Basta, Mary brown, ravindrakumar, Cengage Learning.

Semester	VIII	Course Title	Mobile Communication	Course Code	22EC824
Teaching Period	40 Hours	L – T – P – TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks

Course Objectives:

This course will enable students to

- Understand the requirements for Long term evolution.
- Explore the architectural view of LTE network.
- Identify the requirements and challenges in establishing a 5G network.
- Acquire the knowledge to Categorize the various applications of 5G network.

Module 1

Introduction: Significance and scope of wireless technologies, Importance in the economic growth of the nation. Career perspectives. Impact on national economy, state of art and future directions in mobile communication.

Introduction to LTE: The Context for the Long Term Evolution of UMTS, Requirements and Targets for the Long Term Evolution, Technologies for the Long Term Evolution.

Module 2

Network Architecture: Introduction, Overall Architectural Overview, Protocol Architecture, Quality of Service and EPS Bearers, The E-UTRAN Network Interfaces: S1 Interface, The E- UTRAN Network Interfaces: X2 Interface.

Module 3

Drivers for 5G: The ‘Pervasive Connected World: Introduction, Historical Trend of Wireless Communications, Historical Trend of Wireless Communications, 5G Roadmap, 10 Pillars of 5G, 5G Architecture.

Module 4

The 5G Internet: Introduction, Internet of Things and Context-Awareness, Networking Reconfiguration and Virtualization Support, Mobility, Quality of Service Control, Emerging Approach for Resource Over-Provisioning.

Module 5

Small Cells for 5G Mobile Networks:

Introduction, What are Small Cells, Capacity Limits and Achievable Gains with Densification, Mobile Data Demand, Demand vs Capacity, Small-Cell Challenges, Conclusions and Future Directions.

Co-operation for Next Generation Wireless Networks: Cooperative Diversity and Relaying Strategies, PHY Layer Impact on MAC Protocol Analysis.

Course Outcomes:

After studying this course, students will be able to:

- Describe the basics of cellular networks and its applications, network architecture and 5G networks
- Apply the characteristics/protocols of wireless communication to establish the LTE/5G communication channel.
- Examine the requirements in establishing the LTE/5G communication Network.
- Appraise the challenges in establishing 5G network.

Text Books:

1. Stefania Sesia, Issam Toufik, Matthew Baker, “LTE – The UMTS Long Term Evolution From Theory toPractice”, 2nd Edition, Wiley.
2. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, 2015, Wiley.

Reference Book:

Ramjee Prasad, “5G Outlook – Innovations and Applications”, River Publishers Series in Communications.

Semester	VIII	Course Title	Nano Electronics	Course Code	22EC825
Teaching Period	40 Hours	L – T – P– TL*	3 – 0 – 0 – 3	Credits	3
CIE*	50 Marks	SEE*	50 Marks	Total	100 Marks

Course Objectives:

This course will enable students to:

- Understand the fundamentals, fabrication technologies and applications of Nano scale structures
- Learn about physical background and applications of Nano electronics
- Know about resonant-tunneling devices, transistors and single-electron transfer devices.

Module 1

Introduction: Overview of nanoscience and engineering. Development milestones in micro fabrication and electronic industry, Moore’s law and miniaturization & Classification of Nanostructures.

Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale.

Module 2

Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of Nano systems.

Fabrication techniques: Requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, colloidal quantum dots, self-assembly techniques.

Module 3

Molecular Nano electronics: Electronic and optoelectronic properties of molecular materials - Electrodes & contacts – functions – molecular electronic devices - elementary circuits using organic molecules Organic

materials based rectifying diode switches– TFTs- OLEDs- OTFTs – logic switches.

Memory devices and sensors: Ferroelectric random access memory (RAM), Magnetic RAMS-Field

Sensors – Multi Ferro electric sensors- Spintronic Biosensors.

Module 4

MOSFET: Principles of operation of MOSFET, concept of top of the barrier, Short channel effects, Quantum effects in MOSFET - Coupled Poisson-Schrodinger equations and iterative solutions, quantization in MOSFET channel, quantum capacitance, Tunneling, One dimensional barrier transmission problem, Gate oxide tunneling, Direct source to drain tunneling, Band-to-band tunneling.

Module 5

Nano electronic devices: Introduction to tunneling, Magnetic tunnel junctions, Tunneling spin polarization, Giant tunneling Mgo, Resonant-tunneling diodes, Field-effect transistors, Single-electron- transfer Devices.

Course Outcomes:

After studying this course, Students will be able to

- Understand the basics of nanoscience, molecular structure ,principle of operation & Nano electronic devices.
- Interpret the properties of molecular non material's, fabrication process, memory devices and sensors.
- Analyse and examine the various fabrication methods, elementary circuits developed based on diode switches and tunneling effects in nano devices.
- Design of combinational circuits using discrete gates, MOSFET & various tunneling based diodes and transistors.

TEXT BOOKS:

1. Robert Kelsall, Ian Hamley and Mark Geoghegan, “Nanoscale Science and Technology”, John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, “Introduction to Nanotechnology”, John Wiley, Copyright 2006, Reprint 2011.

3. V. Mitin, V. Kochelap, M. Stroschio, —“Introduction to Nanoelectronics”, Cambridge University Press (2008).

Reference Book:

D. J. Griffiths, “Introduction of Quantum Mechanics”, Prentice Hall.