KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI – 2022

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2022 - 2023 and onwards)

BACHELOR OF ENGINEERING DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

KONGU

Assuring the Best

INDEX

KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 060
(Autonomous)

INSTITUTE VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

INSTITUTE MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens.
- Contribute to the Nation and beyond through research and development
- Continuously improve our services

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To be a centre of excellence for development and dissemination of knowledge in Electronics and Communication Engineering for the Nation and beyond

MISSION

Department of Electronics and Communication Engineering is committed to:

MS1: To impart industry and research based quality education for developing value based electronics and communication engineers

MS2: To enrich the academic activities by continual improvement in the teaching learning process

MS3: To infuse confidence in the minds of students to develop as entrepreneurs

MS4: To develop expertise for consultancy activities by providing thrust for Industry Institute Interaction

MS5: To endeavor for constant upgradation of technical expertise for producing competent professionals to cater to the needs of the society and to meet the global challenges

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduate of Electronics and Communication programme will:

PEO1: Succeed in industry and higher education by applying knowledge of mathematics, science and engineering principles

PEO2: Analyze, design and implement electronics based solutions to meet the real world problems, with constant update of domain knowledge

PEO3: Demonstrate Soft skills, Professional and Ethical values and an aptitude for lifelong learning needed for a successful professional career

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	3	3
MS2	3	3	2
MS3	3	3	3
MS4	3	3	2
MS5	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Electronics and Communication Engineering will**:**

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **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.

PO3 **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.

PO4 **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.

PO5 **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.

PO6 **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.

PO7 **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.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **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.

PO11 **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.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of Electronics and Communication will**:**

PSO1 **Products Development :** Apply multidisciplinary knowledge and skills to develop products for providing solutions for the real world problems in Industry, Agriculture, Healthcare, Communication etc.

PSO2 **Development of Entrepreneurship:** Have an aptitude to take up the applied research to become Entrepreneurs in Electronics and Communication Engineering by combining the skills of project management and finance.

MAPPING OF PEOs WITH POs AND PSOs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	3	3	3	1	-	2	2	2	1	2	3	1
PEO2	3	3	3	3	3	3	3	3	1	2	3	3	3	3
PEO3	-	1	2	-	-	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(Autonomous)

REGULATIONS 2022

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

BACHELOR OF ENGINEERING (BE) / BACHELOR OF TECHNOLOGY (BTech) DEGREE PROGRAMMES

These regulations are applicable to all candidates admitted into BE/BTech Degree programmes from the academic year 2022 – 2023 onwards.

1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

i. "University" means ANNA UNIVERSITY, Chennai.

ii. "College" means KONGU ENGINEERING COLLEGE.

iii. "Programme" means Bachelor of Engineering (BE) / Bachelor of Technology (BTech) Degree programme

iv. "Branch" means specialization or discipline of BE/BTech Degree programme, like Civil Engineering, Information Technology, etc.

v. "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Mathematics, Physics etc.

vi. "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.

vii. "Grade" means the letter grade assigned to each course based on the marks range specified.

viii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.

ix. "Principal" means Chairman, Academic Council of the College.

x. "Controller of Examinations (COE)" means authorized person who is responsible for all examination related activities of the College.

xi. "Head of the Department (HOD)" means Head of the Department concerned.

2. PROGRAMMES AND BRANCHES OF STUDY

The following programmes and branches of study approved by Anna University, Chennai and All India Council for Technical Education, New Delhi are offered by the College.

Programme	Branch
BE	Civil Engineering
	Mechanical Engineering
	Electronics and Communication Engineering
	Computer Science and Engineering
	Electrical and Electronics Engineering
	Electronics and Instrumentation Engineering
	Mechatronics Engineering
	Automobile Engineering
	Computer Science and Design
BTech	Chemical Engineering
	Information Technology
	Food Technology
	Artificial Intelligence and Data Science
	Artificial Intelligence and Machine Learning

3. ADMISSION REQUIREMENTS

3.1 First Semester Admission

The candidates seeking admission to the first semester of the eight semester BE / BTech Degree Programme:

Should have passed the Higher Secondary Examination (10 + 2) in the academic stream with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III subjects of the study conducted by the Government of Tamil Nadu or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

They should also satisfy other eligibility conditions as prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

3.2 Lateral Entry Admission

The candidates who hold a Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of BE / BTech.

(OR)

The candidates who hold a BSc degree in Science(10+2+3 stream) with mathematics as one of the subjects at the BSc level from a recognised University are eligible to apply for Lateral entry admission to the third semester of BE / BTech. Such candidates shall undergo two additional Engineering course(s) in the third and fourth semesters as prescribed by the College.

They should also satisfy other eligibility conditions prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

4. STRUCTURE OF PROGRAMMES

4.1 Categorisation of Courses

The BE / BTech programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training/industrial training, project work, internship, etc that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO), Programme Specific Outcomes (PSO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

i. Humanities and Social Sciences (HS) including Management Courses, English Communication Skills, Universal Human Values and Yoga & Values for Holistic Development.
ii. Basic Science (BS) Courses
iii. Engineering Science (ES) Courses
iv. Professional Core (PC) Courses
v. Professional Elective (PE) Courses
vi. Open Elective (OE) Courses
vii. Employability Enhancement Courses (EC) like Project work, Professional Skills/Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship / In-plant Training in Industry or elsewhere
viii. Audit Courses (AC)
ix. Mandatory Courses (MC) like Student Induction Program and Environmental Science.
x. Honours Degree Courses (HC)

4.2 Credit Assignment and Honours Degree

4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

Contact period per week	Credits
1 Lecture / Tutorial Period	1
2 Practical Periods	1
2 Project Work Periods	1
40 Training / Internship Periods	1

The minimum number of credits to complete the BE/BTech programme is 168.

4.2.2 Honours Degree

If a candidate earns 18 to 20 additional credits in an emerging area, then he/she can be awarded with Honours degree mentioning that emerging area as his/her specialization. The respective board of studies shall recommend the specializations for honours degree and appropriate additional courses to be studied by the candidate which shall get approval from Academic Council

of the institution. A candidate shall have not less than 7.5 CGPA and no history of arrears to opt for the honours degree and has to maintain the same during the entire programme.
Various specializations for various branches recommended by the respective boards of studies are given below:

SNo	Specializations for Honours degree in emerging areas	To be offered as Honours, Only for the following branches mentioned against the specialization
1.	Construction Technology	BE – Civil Engineering
2.	Smart Cities	BE – Civil Engineering
3.	Smart Manufacturing *	BE – Mechanical Engineering
4.	Computational Product Design *	BE – Mechanical Engineering
5.	Intelligent Autonomous Systems *	BE – Mechatronics Engineering
6.	E-Mobility *	BE – Automobile Engineering
7.	Artificial Intelligence and Machine Learning	BE – Electronics and Communication Engineering
8.	System on Chip Design *	BE – Electronics and Communication Engineering
9.	Electric Vehicles	BE – Electrical and Electronics Engineering
10.	Microgrid Technologies	BE – Electrical and Electronics Engineering
11.	Intelligent Sensors Technology *	BE – Electronics and Instrumentation Engineering
12.	Smart Industrial Automation *	BE – Electronics and Instrumentation Engineering
13.	Data Science	BE – Computer Science and Engineering
14.	Cyber Security	BE – Computer Science and Engineering
15.	Data Science	BTech – Information Technology
16.	Cyber Security	BTech – Information Technology
17.	Petroleum and Petrochemical Engineering *	BTech – Chemical Engineering
18.	Waste Technology *	BTech – Chemical Engineering
19.	Food Processing and Management *	BTech – Food Technology
20.	Virtual and Augumented Reality	BE- Computer Science and Design
21.	Data Science	BE- Computer Science and Design
22.	Internet of Things (IoT)	BTech – Artificial Intelligence and Data Science
23.	Blockchain	BTech – Artificial Intelligence and Data Science
24.	Internet of Things (IoT)	BTech – Artificial Intelligence and Machine Learning
25.	Blockchain	BTech – Artificial Intelligence and Machine Learning

*Title by KEC

The courses specified under Honours degree in the emerging area may include theory, theory cum practical, practical, project work, etc. under the particular specialization. A candidate can choose and study these specified courses from fourth semester onwards and he/she shall successfully complete the courses within the stipulated time vide clause 5. Total number of credits earned in each semester may vary from candidate to candidate based on the courses chosen. The registration, assessment & evaluation pattern and classification of grades of these courses shall be the same as that of the courses in the regular curriculum of the programme of the candidate vide clause 6, clause 7 and clause 15 respectively. A candidate can earn Honours degree in only one specialization during the entire duration of the programme.

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project work, internship, professional skills training/industrial training, comprehensive test & viva, and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/ Indsutrial Training/Entrepreneurships/Start Ups/ Inplant Training

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in two phases as phase I in fourth semester and phase II in fifth semester including vacation periods and each phase can carry two credits.

(OR)

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in fifth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in fifth semester. He/She shall attend Professional Skills Training Phase I in fourth semester and can earn two credits.

(OR)

A candidate may be allowed to set up a start up and working part-time for the start ups by applying his/her innovations and can become a student entrepreneur during BE/BTech programme. Candidates can set up their start up from fifth semester onwards either inside or outside of the college. Such student entrepreneurs may earn 2 credits in place of Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

4.3.2 Comprehensive Test and Viva

The overall knowledge of the candidate in various courses he/she studied shall be evaluated by (i) conducting comprehensive tests with multiple choice questions generally with pattern similar to GATE and/or (ii) viva-voce examination conducted by a panel of experts assigned by the Head of the department. The members can examine the knowledge of the candidate by asking questions from various domains and the marks will be assigned based on their answers. This course shall carry two credits.

4.3.3 Full Time Project through Internships

The curriculum enables a candidate to go for full time project through internship during a part of seventh semester and/or entire final semester and can earn credits vide clause 7.6 and clause 7.11.

A candidate is permitted to go for full time projects through internship in seventh semester with the following condition: The candidate shall complete a part of the seventh semester courses with a total credit of about 50% of the total credits of seventh semester including Project Work-II Phase-I in the first two months from the commencement of the seventh semester under fast track mode. The balance credits required to complete the seventh semester shall be earned by the candidate through either approved One/Two Credit Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

A candidate is permitted to go for full time projects through internship during eighth semester. Such candidate shall earn the minimum number of credits required to complete eighth semester other than project through either approved One / Two Credit Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

4.3.4 A student shall go for in-plant training for duration of two weeks during the entire programme. It is mandatory for all the students.

4.4 One / Two Credit Courses / Online Courses / Self Study Courses

The candidates may optionally undergo One / Two Credit Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 **One / Two Credit Courses:** One / Two credit courses shall be offered by the college with the prior approval from respective Board of Studies. A candidate can earn a maximum of six credits through one / two credit courses during the entire duration of the programme.

4.4.2 **Online Courses:** Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by respective Board of Studies.

4.4.3 **Self Study Courses:** The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the respective Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty following due approval procedure. Self study course is limited to one per semester.

4.4.4 The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance.

4.4.5 A candidate can earn a maximum of 30 credits through all one / two credit courses, online courses and self study courses.

4.5 Flexibility to Add or Drop Courses

4.5.1 A candidate has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.

4.5.2 From the first to seventh semesters the candidates have the option of registering for additional elective/Honours courses or dropping of already registered additional elective/Honours courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates.

4.6 Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.

4.7 The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.

4.8 The medium of instruction, examinations and project report shall be English.

5. DURATION OF THE PROGRAMME

5.1 A candidate is normally expected to complete the BE / BTech Degree programme in 8 consecutive semesters/4 Years (6 semesters/3 Years for lateral entry candidate), but in any case not more than 14 semesters/7 Years (12 semesters/6 Years for lateral entry candidate).

5.2 Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

6. COURSE REGISTRATION FOR THE EXAMINATION

6.1 Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.

6.2 The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8) and earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.

6.3 If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.

6.4 A candidate shall register for the chosen courses as well as arrear courses (if any vide clause 6.2 and 6.3) from the list of courses specified under Honours degree.

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1 The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Comprehensive Test and Viva, Project Work, Industrial Training /Professional Skills Training, Internship/In-plant Training and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory	40	60
2.	Theory cum Practical (The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.)	50	50
3.	Practical	60	40
4.	Professional Skills Training / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work I / Mandatory Course/Industrial Training/ Universal Human Values / Yoga and Values for Holistic Development	100	---
5.	Project Work II Phase I / Project Work II Phase II / Internships	50	50
6.	One / Two credit Course	The distribution of marks shall be decided based on the credit weightage assigned	---
7.	All other Courses		

7.2 Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, internships and entrepreneurships/start ups shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 40 marks and the end semester examination shall be for 60 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 60. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

7.3.1 The assessment pattern for awarding continuous assessment marks shall be as follows:

Sl. No.	Type	Max. Marks	Remarks
1.	Test - I	20	Average of best 2 tests (20 marks)
	Test - II	20	
	Test - III	20	
2.	Tutorial: (Tutorial/Problem Solving (or) Simulation (or) Simulation & Mini Project (or) Mini Project (or) Case Studies (or) Any other relevant to the course)	15	Type of assessment is to be chosen based on the nature of the course and to be approved by Principal
3.	Others: Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
	Total	40	Rounded off to the one decimal place

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

7.3.2 A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).

7.3.3 The end semester examination for theory courses shall be for a duration of three hours and shall be conducted between November and January during odd semesters and between April and June during even semesters of every year.

7.4 Theory cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 60 marks and the end semester examination shall be for 40 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidates' records shall be maintained.

7.5.1 The assessment pattern for awarding continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course, and shall be based on rubrics for each experiment.

7.5.2 The end semester examination shall be conducted for a maximum of 100 marks for duration of 3 hours and reduced to 40 marks. The appointment of examiners and the schedule shall be decided by chairman of Board of Study of the relevant board.

7.6 Project Work II Phase I / Project Work II Phase II

7.6.1 Project work shall be assigned to a single candidate or to a group of candidates not exceeding 4 candidates in a group. The project work is mandatory for all the candidates.

7.6.2 The Head of the Department shall constitute review committee for project work. There shall be two assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.

7.6.3 The continuous assessment and end semester examination marks for Project Work II Phase I /Project Work II Phase II and the Viva-Voce Examination shall be distributed as below.

Continuous Assessment (Max. 50 Marks)						End Semester Examination (Max. 50 Marks)			
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max. 30 Marks)		Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)		
Rv. Com	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee (excluding supervisor)	Supervisor	Ext. Exr.	Supervisor	Exr. 1	Exr. 2
0	0	10	10	15	15	20	10	10	10

7.6.4 The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.

7.6.5 If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

7.6.6 The end semester examination of the project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and supervisor of the project work.

7.6.7 If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.6.

7.6.8 A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

7.7 Project Work I / Industrial Training

The evaluation method shall be same as that of the Project Work II as per clause 7.6 excluding 7.6.3, 7.6.5, 7.6.6 and 7.6.7. The marks distribution is given below.

Continuous Assessment (Max. 100 Marks)								
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max.. 30 Marks)		Review III (Max. 50 Marks)		
						Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)	
Review Committee	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee	Supervisor	Review Committee
0	0	10	10	15	15	20	10	20

If a candidate fails to secure 50 % of the continuous assessment marks in this course, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted.

7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 3rd semester vacation and during 4th semester. Phase II training shall be conducted for minimum of 80 hours in 4th semester vacation and during 5th semester. The evaluation procedure shall be approved by the board of the offering department and Principal.

7.9 Comprehensive Test and Viva

A candidate can earn 2 credits by successfully completing this course. The evaluation procedures shall be approved by the Principal.

7.10 Entrepreneurships/ Start ups

A start up/business model may be started by a candidate individually or by a group of maximum of three candidates during the programme vide clause 4.3.1. The head of the department concerned shall assign a faculty member as a mentor for each start up.

A review committee shall be formed by the Principal for reviewing the progress of the Start ups / Business models, innovativeness, etc. The review committee can recommend the appropriate grades for academic performance for the candidate(s) involved in the start ups. This course shall carry a maximum of two credits in fifth semester and shall be evaluated through continuous assessments for a maximum of 100 marks vide clause 7.1. A report about the start ups is to be submitted to the review committee for evaluation for each start up and the marks will be given to Controller of Examinations after getting approval from Principal.

7.11 In-Plant Training

Each candidate shall go for In-Plant training for a duration of minimum of two weeks during the entire programme of study and submit a brief report about the training undergone and a certificate issued from the organization concerned.

7.12 One / Twe Credit Courses

For all one/ two credit courses out of 100 marks, the continuous assessment shall be 50 marks and the model examination shall be for 50 marks. Minimum of two continuous assessments tests shall be conducted during the one / two credit course duration by the offering department concerned. Model examination shall be conducted at the end of the course.

7.13 Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

7.14 Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

7.15 Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.

The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.

A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements (vide clause 7.3) applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SC (Successfully Completed). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

7.16 Mandatory Courses

A candidate joined in first semester shall attend and complete a mandatory course namely Student Induction Program of duration three weeks at the beginning of first semester. The candidates studying in second year shall attend and complete another one mandatory course namely Environmental Science. No credits shall be given for mandatory courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Upon the successful completion, these courses will be listed in the semester grade sheet and in the consolidated grade sheet with the grade “SC” (Successfully Completed). Since no grade points are assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

7.17 Universal Human Values (UHV) and Yoga and Values for Holistic Development (YVHD)

Courses YVHD shall be offered to all first year candidates of all BE/ BTech programmes to impart knowledge on yoga and human values. Course UHV shall be offered to all the second year BE/ BTech students. These courses shall carry a maximum of 100 marks each and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits for UHV and 1 credit for YVHD by successfully completing these courses. Two continuous assessment tests will be conducted and the average marks will be taken for the calculation of grades.

8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

8.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.

8.1.1 Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.

8.1.2 A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to his/her entrepreneurships/ start ups activities, but has secured not less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

8.1.3 In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.

8.1.4 A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.

8.1.5 Candidate's progress is satisfactory.

8.1.6 Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.

8.2. The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.

8.3 The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester when it is offered next.

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

9.1 A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.

9.2 When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.

9.3 A candidate who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

10.1 A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.

10.2 The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.

10.3 The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.

10.4 If a candidate withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.

10.5 The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

11. PROVISION FOR BREAK OF STUDY

11.1 A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination. A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

11.2 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.

11.3 The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

11.4 The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.

11.5 If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.

11.6 If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

12. PASSING REQUIREMENTS

12.1 A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.

12.2 A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

12.3 For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements.

13. REVALUATION OF ANSWER SCRIPTS

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

15. AWARD OF LETTER GRADES:

For all the passed candidates, the relative grading principle is applied to assign the letter grades.

Marks / Examination Status	Letter Grade	Grade Point
Based on the relative grading	O (Outstanding)	10
	A+ (Excellent)	9
	A (Very Good)	8
	B+ (Good)	7
	B (Average)	6
	C (Satisfactory)	5
Less than 50	U (Reappearance)	0
Successfully Completed	SC	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

The Grade Point Average (GPA) is calculated using the formula:

$$\text{GPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in the specific semester}}{\sum(\text{course credits}) \text{ for all courses in the specific semester}}$$

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

$$\text{CGPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in all the semesters so far}}{\sum(\text{course credits}) \text{ for all courses in all the semesters so far}}$$

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the BE / BTech Degree provided the candidate has

i. Successfully completed all the courses under the different categories, as specified in the regulations.
ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).

iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2022 (vide clause 11.3)

iv. No disciplinary action pending against him / her.

17. CLASSIFICATION OF THE DEGREE AWARDED

17.1 First Class with Distinction:

17.1.1. A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50

(OR)

17.1.2 A candidate who joins from other institutions on transfer or a candidate who gets readmitted and has to move from one regulations to another regulations and who qualifies for the award of the degree (vide clause 16) and satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Submission of equivalent course list approved by the respective Board of studies.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 9.00

17.2 First Class:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry candidates) within ten consecutive semesters (eight consecutive semesters for lateral entry candidates) excluding authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 6.50

17.3 Second Class:
All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

17.4 A candidate who is absent for end semester examination in a course / project work after having registered for the same shall be considered to have appeared for that examination for the purpose of classification.

17.5 Honors Degree:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have earned the BE/BTech degree with Honours (vide clause 16 and clause 4.2.2):

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 7.50

18. MALPRACTICES IN TESTS AND EXAMINATIONS

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

19. AMENDMENTS

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its BE / BTech programme.

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CURRICULUM BREAKDOWN STRUCTURE – R2022										
Summary of Credit Distribution										
Category	**Semester**								**Total number of credits**	**Curriculum Content (% of total number of credits of the program)**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
HS	3	5	3	1			3		15	8.92
BS	8	8	4						20	11.90
ES	8	8	4	4					24	14.28
PC	3	4	12	16	15	8			58	34.52
PE					3	3	9	3	18	10.71
OE					4	4	3	3	14	8.33
EC				2	2	6	5	4	19	11.30
MC	0					0			0	0
Semester wise Total	22	25	23	23	24	21	20	10	168	100.00

Category	Abbreviation
Lecture hours per week	**L**
Tutorial hours per week	**T**
Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week	**P**
Credits	**C**

CATEGORISATION OF COURSES							
HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22EGT11	Communication Skills I	3	0	0	3	I
2.	22TAM02	Tamils and Technology	1	0	0	1	II
3.	22EGT21	Communication Skills II	3	0	0	3	II
4.	22VEC11	Yoga and Values for Holistic Education	--	--	--	1	II
5.	22TAM01	Heritage of Tamils	1	0	0	1	III
6.	22GET31	Universal Human Values	2	0	0	2	III
7.	22EGL31	Communication Skills Development Laboratory	0	0	2	1	IV
8.	22GET71	Engineering Economics and Management	3	0	0	3	VII
Total Credits to be earned						**15**	

BASIC SCIENCE (BS)							
S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	I
2.	22CYT11	Chemistry for Electronics and Communication Engineering	3	0	0	3	I
4.	22CYL11	Chemistry Laboratory for Electrical Systems	0	0	2	1	I
6.	22PHT21	Physics for Electronics and Communication Engineering	3	0	0	3	II
7.	22PHL21	Physics Laboratory for Electronics and Communication Engineering	0	0	2	1	II
8.	22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	II
9.	22MAT33	Transforms and Probability Theory	3	1	0	4	III
Total Credits to be earned						**20**	

ENGINEERING SCIENCE (ES)							
S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22MAC11	Problem Solving and Programming in C	3	0	2	4	I
2.	22ECT12	Basics of Electrical and Electronics Engineering	3	0	0	3	I
3.	22ECL11	Basics of Electrical and Electronics Engineering Laboratory	0	0	2	1	I
4.	22CSC21	Data Structures using C	3	0	2	4	II
5.	22MET11	Engineering Drawing	2	1	0	3	II
6.	22MEL11	Engineering Practices Laboratory	0	0	2	1	II
7.	22ITC31	Java Programming	3	0	2	4	III
8.	22ITC41	Programming In Python	3	0	2	4	IV
Total Credits to be earned						**24**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	22ECT11	Circuits and Networks	3	0	0	3	I	EL
2.	22ECT21	Electromagnetic fields	3	1	0	4	II	EL
3.	22ECT31	Digital Electronics	3	0	0	3	III	VD
4.	22ECT32	Electronic Circuits	3	0	0	3	III	EL
5.	22ECC31	Linear Integrated Circuits	3	0	2	4	III	EL
6.	22ECL31	Digital Electronics Laboratory	0	0	2	1	III	VD
7.	22ECL32	Electronic Circuits Laboratory	0	0	2	1	III	EL
8.	22ECT41	Digital Signal Processing	3	1	0	4	IV	SIP
9.	22ECT42	Microprocessor and Microcontroller	3	0	0	3	IV	ES
10.	22ECT43	Transmission Lines and Waveguides	3	0	0	3	IV	CN
11.	22ECT44	Control Engineering	3	1	0	4	IV	EL
12.	22ECL41	Digital Signal Processing Laboratory	0	0	2	1	IV	VD
13.	22ECL42	Microprocessor and Microcontroller Laboratory	0	0	2	1	IV	ES
14.	22ECT51	VLSI Design	3	0	0	3	V	SIP
15.	22ECT52	Analog and Digital Communication	3	0	0	3	V	CN
16.	22ECC51	Embedded Systems and IoT	2	0	2	3	V	ES
17.	22ECC52	Antennas and Wave Propagation	3	0	2	4	V	CN
18.	22ECL51	VLSI Design Laboratory	0	0	2	1	V	SIP
19.	22ECL52	Analog and Digital Communication Laboratory	0	0	2	1	V	CN
20.	22ECT61	Microwave and Optical Communication	3	0	0	3	VI	CN
21.	22ECT62	Data Communication and Networking	3	0	0	3	VI	CN
22.	22ECL61	Microwave and Optical Communication Laboratory	0	0	2	1	VI	CN
23.	22ECL62	Data Communication and Networking Laboratory	0	0	2	1	VI	CN
Total Credits to be earned						**58**		

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester - V							
Elective – I							
1.	22ECF01	Modern Electronic Instrumentation	2	0	2	3	EL
2.	22ECE01	Medical Electronics	3	0	0	3	EL
3.	22ECE02	Computer Architecture and Interfacing	3	0	0	3	EL
4.	22ECE03	Embedded System Design	3	0	0	3	ES
5.	22ECF02	Digital Image Processing and its Applications	2	0	2	3	SIP
6.	22ECF03	Artificial Intelligence and Machine Learning	2	0	2	3	SIP
7.	22ECF04	Linux Operating System	2	0	2	3	SD
8.	22ECE04	Data Science for Engineers	3	0	0	3	SD
Semester - VI							
Elective – II							
9.	22ECE05	Mobile Communication	3	0	0	3	CN
10.	22ECE06	Embedded Architecture and Standards	3	0	0	3	ES
11.	22ECF05	Electronics Circuit Board Design	2	0	2	3	EL
12.	22ECF06	Single Board Computer	2	0	2	3	ES
13.	22ECF07	ASIC Design	2	0	2	3	VD
14.	22ECF08	Soft Computing Techniques	2	0	2	3	SIP
15.	22ECF09	DSP Processor and its Applications	2	0	2	3	SIP
16.	22ECF10	Deep Learning and its Applications	2	0	2	3	SIP
Semester - VII							
Elective - III							
17.	22ECE07	Wireless Broadband Communication	3	0	0	3	CN
18.	22ECE08	Network Information Security	3	0	0	3	CN
19.	22ECE09	Real Time Operating System	3	0	0	3	ES
20.	22ECF11	Scripting languages for VLSI	2	0	2	3	VD
21.	22ECE10	Quantum Computing and Information	3	0	0	3	VD
22.	22ECF12	Wavelet Transform and its Applications	2	0	2	3	SIP
23.	22ECF133	Computer Vision	2	0	2	3	SIP
24.	22ECE11	Edge Computing	3	0	0	3	SD

Elective – IV							
25.	22ECE12	Satellite Communication	3	0	0	3	CN
26.	22ECE13	Wireless Networks	3	0	0	3	CN
27.	22ECE14	RISC Architecture	3	0	0	3	ES
28.	22ECE15	System Verilog	3	0	0	3	VD
29.	22ECE16	Neural Science for Engineers	3	0	0	3	SIP
30.	22ECE17	Remote Sensing	3	0	0	3	SIP
31.	22ECE18	Natural Language Processing	3	0	0	3	SIP
32.	22ECE19	Blockchain Technology	3	0	0	3	SD
Elective - V							
33.	22ECE20	Next Generation Wireless Communication Systems	3	0	0	3	CN
34.	22ECE21	Radar Engineering	3	0	0	3	CN
35.	22ECE22	Automotive Electronic Systems	3	0	0	3	EL
36.	22ECE23	Wireless Sensor Networks	3	0	0	3	ES
37.	22ECE24	Industry 4.0	3	0	0	3	ES
38.	22ECE25	Testing and Fault Diagnosis of VLSI Circuits	3	0	0	3	VD
39.	22ECE26	MEMS Design	3	0	0	3	VD
40.	22ECE27	Software Quality Assurance and Testing	3	0	0	3	SD
Semester - VIII							
Elective - VI							
41.	22ECE28	Software Defined Radio	3	0	0	3	CN
42.	22ECE29	RF Communications	3	0	0	3	CN
43.	22ECF14	Wearable Technology	2	0	2	3	ES
44.	22ECE30	Cyber Physical Systems	3	0	0	3	ES
45.	22ECE31	NanoTechnology For Energy Sustainability	3	0	0	3	VD
46.	22ECE32	Low Power VLSI Design	3	0	0	3	VD
47.	22ECE33	Brain Computer Interface and Applications	3	0	0	3	SIP
Total Credits to be earned						**18**	

***** Domain/Stream Abbreviations: AUTO - Automobile, DSN - Design, EE–Electrical and Electronics, TF–Thermal and Fluid, MFG- Manufacturing, GE – General Engineering

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22GEL41	Professional Skills Training I	-	-	-	2	IV
2.	22GEL51	Professional Skills Training II	-	-	-	2	V
3.	22ECP61	Project Work I	0	0	8	4	VI
4.	22GEP61	Comprehensive Test and Viva	2	0	0	2	VI
5.	22ECP71	Project Work II Phase I	0	0	10	5	VII
6.	22ECP81	Project Work II Phase II	0	0	8	4	VIII
Total Credits to be earned						**19**	

MANDATORY COURSES (MC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22MNT11	Student Induction Program	--	--	--	0	I
2.	22MNT31	Environmental Science	2	0	0	0	VI
Total Credits to be earned						**0**	

LIST OF OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OEs)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22ECX01	Basics of Electronics in Automation Appliances	3	0	2	4	V
2.	22ECX02	Image Processing	3	0	2	4	V
3.	22ECX03	PCB Design and Fabrication	3	0	2	4	VI
4.	22ECO01	Wearable Devices	3	0	0	3	VII
5.	22ECX04	Electronic Hardware and Troubleshooting	2	0	2	3	VII
6.	22ECO02	Optical Engineering	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**OFFERED BY**
SEMESTER V							
1.	22CEX01	Remote Sensing and its Applications	3	0	2	4	CIVIL
2.	22MEX01	Renewable Energy Sources	3	0	2	4	MECH
3.	22MTO01	Design of Mechatronics Systems	3	1	0	4	MTS
4.	22MTX01	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
5.	22MTX02	Factory Automation	3	0	2	4	MTS
6.	22AUX01	Automotive Engineering	3	0	2	4	AUTO

7.	22ECX01	Basics of Electronics in Automation Appliances	3	0	2	4	ECE
8.	22ECX02	Image Processing	3	0	2	4	ECE
9.	22EEO01	Solar and Wind Energy Systems	3	1	0	4	EEE
10.	22EEO02	Electrical Wiring and Lighting	3	1	0	4	EEE
11.	22EEO03	Programmable Logic Controller and SCADA	3	1	0	4	EEE
12.	22EEO04	Analog and Digital Electronics	3	1	0	4	EEE
13.	22EEO05	Power Electronics and Drives	3	1	0	4	EEE
14.	22EEO06	Sensors and Actuators	3	1	0	4	EEE
15.	22EIO01	Measurements and Instrumentation	3	1	0	4	EIE
16.	22EIO02	Biomedical Instrumentation and Applications	3	1	0	4	EIE
17.	22EIO03	Industrial Automation	3	1	0	4	EIE
18.	22CSX01	Fundamentals of Databases	3	0	2	4	CSE
19.	22CSX02	Data science for Engineers	3	0	2	4	CSE
20.	22CSX03	Enterprise Application Development Using Java	3	0	2	4	CSE
21.	22CSO01	Computational science for Engineers	3	1	0	4	CSE
22.	22CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE
23.	22ITO01	Artificial Intelligence	3	1	0	4	IT
24.	22ITX01	Next Generation Databases	3	0	2	4	IT
25.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT
26.	22CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD
27.	22ADO01	Data Warehousing and Data Mining	3	1	0	4	AIDS
28.	22ALO01	Business Intelligence	3	1	0	4	AIML
29.	22CHO01	Industrial Enzymology	3	1	0	4	CHEM
30.	22CHO02	Waste to Energy Conversion	3	1	0	4	CHEM
31.	22CHO03	Applied Nanotechnology	3	1	0	4	CHEM
32.	22FTX01	Baking Technology	3	0	2	4	FT
33.	22FTO01	Food Processing Technology	3	1	0	4	FT
34.	22MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
35.	22MAO02	Numerical Computing	3	1	0	4	MATHS
36.	22MAO03	Stochastic Processes and Queuing Theory	3	1	0	4	MATHS

37.	22MAO04	Statistics for Engineers	3	1	0	4	MATHS
38.	22PHO01	Thin Film Technology	3	1	0	4	PHYSICS
39.	22PHO02	High Energy Storage Devices	3	1	0	4	PHYSICS
40.	22PHO03	Structural and Optical Characterization of Materials	3	1	0	4	PHYSICS
41.	22CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMISTRY
42.	22CYO02	Chemistry Concepts for Competitive Examinations	3	1	0	4	CHEMISTRY
43.	22CYO03	Organic Chemistry for Industry	3	1	0	4	CHEMISTRY
SEMESTER VI							
44.	22CEO01	Disaster Management	3	1	0	4	CIVIL
45.	22MEX02	Design of Experiments	3	0	2	4	MECH
46.	22MTO02	Robotics	3	1	0	4	MTS
47.	22MTO03	3D Printing and Design	3	1	0	4	MTS
48.	22AUO01	Automotive Electronics	3	1	0	4	ECE
49.	22ECX03	PCB Design and Fabrication	3	0	2	4	ECE
50.	22EEO07	Energy Conservation and Management	3	1	0	4	EEE
51.	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	EEE
52.	22EEO09	Electrical Safety	3	1	0	4	EEE
53.	22EEO10	VLSI System Design	3	1	0	4	EEE
54.	22EEO11	Automation for Industrial Applications	3	1	0	4	EEE
55.	22EIO04	PLC Programming with High Level Languages	3	1	0	4	EIE
56.	22EIO05	Virtual Instrumentation	3	1	0	4	EIE
57.	22CSX04	Foundations of Machine Learning	3	0	2	4	CSE
58.	22CSX05	Web Engineering	3	0	2	4	CSE
59.	22ITX02	Advanced Java Programming	3	0	2	4	IT
60.	22ITO02	Internet of Things	3	1	0	4	IT
61.	22ITO03	Fundamentals of Software Development	3	1	0	4	IT
62.	22ITO04	Mobile Application Development	3	1	0	4	IT
63.	22CDX01	Fundamentals of User Interactive Design	3	0	2	4	CSD
64.	22ADX01	Data Visualization	3	0	2	4	AIDS
65.	22ALX01	Data Exploration and Visualization Techniques	3	0	2	4	AIML
66.	22CHO04	Air Pollution Monitoring and Control	3	1	0	4	CHEM

67.	22CHO05	Paints and Coatings	3	1	0	4	CHEM
68.	22CHO06	Powder Technology	3	1	0	4	CHEM
	22FTX02	Processing of milk and milk products	3	0	2	4	FT
	22FTX03	Processing of Fruits and Vegetables	3	0	2	4	FT
69.	22MAO05	Graph Theory and its Applications	3	1	0	4	MATHS
70.	22MAX01	Data Analytics using R Programming	3	0	2	4	MATHS
71.	22MAO06	Operations Research	3	1	0	4	MATHS
72.	22MAO07	Number Theory and Cryptography	3	1	0	4	MATHS
73.	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	3	1	0	4	PHYSICS
74.	22PHO05	Techniques of Crystal Growth	3	1	0	4	PHYSICS
75.	22CYO04	Corrosion Science and Engineering	3	1	0	4	CHEMISTRY
76.	22CYO05	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMISTRY
77.	22CYO06	Nanocomposite Materials	3	1	0	4	CHEMISTRY
SEMESTER VII							
78.	22CEO02	Introduction to Smart Cities	3	0	0	3	CIVIL
79.	22CEO03	Environmental Health and Safety	3	0	0	3	CIVIL
80.	22MEO01	Fundamentals of Ergonomics	3	0	0	3	MECH
81.	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	MECH
82.	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	MECH
83.	22MTO04	Drone System Technology	3	0	0	3	MTS
84.	22AUO02	Vehicle Maintenance	3	0	0	3	AUTO
85.	22ECO01	Wearable Devices	3	0	0	3	ECE
86.	22ECX04	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
87.	22EEO12	Electric Vehicle	3	0	0	3	EEE
88.	22EEO13	E-Waste Management	3	0	0	3	EEE
89.	22EEO14	Embedded System Design	3	0	0	3	EEE
90.	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	EEE
91.	22EEO16	AI Techniques for Engineering Applications	3	0	0	3	EEE
92.	22EIO06	Introduction to Distributed Control Systems	3	0	0	3	EIE
93.	22EIO07	Instrumentation in Aircraft Navigation and Control	3	0	0	3	EIE

94.	22EIO08	Industry 4.0 with Industrial IoT	3	0	0	3	EIE
95.	22EIO09	Industrial Data Communication	3	0	0	3	EIE
96.	22EIO10	Wireless Instrumentation	3	0	0	3	EIE
97.	22EIO11	Instrumentation Techniques in Agriculture	3	0	0	3	EIE
98.	22CSO03	Nature Inspired optimization techniques	3	0	0	3	CSE
99.	22ITO05	Fundamentals of Cloud Computing	3	0	0	3	IT
100.	22CDO02	Introduction to Mobile Game Design	3	0	0	3	CSD
101.	22CDO03	Introduction to Graphics Design	3	0	0	3	CSD
102.	22ADO02	Neural Networks and Deep Learning	3	0	0	3	AIDS
103.	22ALO02	Industrial Machine Learning	3	0	0	3	AIML
104.	22CHO07	Hydrogen Energy	3	0	0	3	CHEM
105.	22CHO08	Rubber Technology	3	0	0	3	CHEM
106.	22FTO02	Principles of Food safety	3	0	0	3	FT
107.	22FTO03	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
108.	22MAO08	Non-Linear Optimization	3	0	0	3	MATHS
109.	22MAO09	Optimization for Engineers	3	0	0	3	MATHS
110.	22CYO07	Waste and Hazardous Waste Management	3	0	0	3	CHEMISTRY
111.	22CYO08	Chemistry in Every day Life	3	0	0	3	CHEMISTRY
SEMESTER VIII							
112.	22CEO04	Infrastructure Planning and Management	3	0	0	3	CIVIL
113.	22CEO05	Environmental Laws and Policy	3	0	0	3	CIVIL
114.	22MEO04	Safety Measures for Engineers	3	0	0	3	MECH
115.	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
116.	22MEO06	Climate Change and New Energy Technology	3	0	0	3	MECH
117.	22MTO05	Micro and Nano Electromechanical Systems	3	0	0	3	MTS
118.	22AUO03	Public Transport Management	3	0	0	3	ECE
119.	22AUO04	Autonomous Vehicles	3	0	0	3	ECE
120.	22ECO02	Optical Engineering	3	0	0	3	EEE
121.	22EEO17	Smart Grid Technologies	3	0	0	3	EEE
122.	22EEO18	Biomass Energy Systems	3	0	0	3	EEE
123.	22EIO12	Environmental Sensors	3	0	0	3	EIE

124.	22EIO13	Pollution Control and Management	3	0	0	3	EIE
125.	22CSO04	Machine Translation	3	0	0	3	CSE
126.	22CSO05	Fundamentals of Blockchain	3	0	0	3	CSE
127.	22ITO06	Introduction to Ethical Hacking	3	0	0	3	IT
128.	22ITO07	Business Continuity Planning	3	0	0	3	IT
129.	22CDX02	Virtual Reality and Augmented Reality	3	0	0	3	CSD
130.	22ADO03	Business Analytics	3	0	0	3	AIDS
131.	22ALO03	Machine Learning for Smart Cities	3	0	0	3	AIML
132.	22CHO09	Industrial Accident Prevention and Management	3	0	0	3	CHEM
133.	22CHO10	Electrochemical Engineering	3	0	0	3	CHEM
134.	22CHO11	Smart and Functional Materials	3	0	0	3	CHEM
135.	22FTO04	Food Ingredients	3	0	0	3	FT
136.	22FTO05	Food and Nutrition	3	0	0	3	FT
137.	22CYO09	Chemistry of Nutrition for Women Health	3	0	0	3	CHEMISTRY

GENERAL OPEN ELECTIVE
(Common to All BE/BTech branches)

SNo	Course Code	**Course Title**	L	T	P	C	Offering Department	Semester
1.	22GEO01	German Language Level 1	4	0	0	4	ECE	ALL
2.	22GEO02	Japanese Language Level 1	4	0	0	4	ECE	ALL
3.	22GEO03	Design Thinking for Engineers	3	1	0	4	CSE	5
4.	22GEO04	Innovation and Business Model Development	3	1	0	4	MTS	6
5.	22GEO05	German Language Level 2	4	0	0	4	ECE	ALL
6.	22GEO06	German Language Level 3	3	0	0	3	ECE	ALL
7.	22GEO07	German Language Level 4	3	0	0	3	ECE	ALL
8.	22GEO08	Japanese Language Level 2	4	0	0	4	ECE	ALL
9.	22GEO09	Japanese Language Level 3	3	0	0	3	ECE	ALL
10.	22GEO10	Japanese Language Level 4	3	0	0	3	ECE	ALL
11.	22GEO11	French Language Level 1	4	0	0	4	ECE	ALL
12.	22GEO12	French Language Level 2	4	0	0	4	ECE	ALL
13.	22GEO13	French Language Level 3	3	0	0	3	ECE	ALL
14.	22GEO14	Spanish Language Level 1	4	0	0	4	ECE	ALL
15.	22GEO15	Spanish Language Level 2	4	0	0	4	ECE	ALL
16.	22GEO16	Spanish Language Level 3	3	0	0	3	ECE	ALL
17.	22GEO17	Entrepreneurship Development	3	0	0	3	MTS	7
18.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	EEE	5 / 6
19.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT	5 / 6
20.	22MBO01	Cost Accounting for Engineers	3	1	0	4	MBA	5
21.	22MBO02	Economic Analysis for Decision Making	3	1	0	4	MBA	6
22.	22MBO03	Marketing Analytics	3	1	0	4	MBA	7

KECR2022: SCHEDULING OF COURSES – BE (Electronics and Communication Engineering) Total Credits: 168

Sem	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	CH
I	22EGT11 Communication Skills –I (3-0-0-3)	22MAC11 Matrices and Ordinary Differential Equations (3- 1*-2*-4)	22CYT11 Chemistry for Electronics and Communication Engineering (3-0-0-3)	22ECT11 Circuits and Networks (3-0-0-3)	22CSC11 Problem Solving and Programming in C (3-0-2-4)	22ECT12 Basics of Electrical and Electronics Engineering (3-0-0-3)	22ECL11 Basics of Electronics and Electrical Engineering Laboratory (0-0-2-1)	22CYL11 Chemistry Laboratory for Electrical Systems (0-0-2-1)	22MNT11 Student Induction Program (-- - -0)		22
II	22GET21 Communication Skills –II (3-0-0-3)	22MAC21 Multivariable Calculus and Complex Analysis (3-1*-2*-4)	22PHT21 Physics for Electronics and Communication Engineering (3-0-0-3)	22ECT21 Electromagnetic fields (3-1-0-4)	22CSC21 Data Structures using C (3-0-2-4)	22MET11 Engineering Drawing (2-1-0-3)	22TAM02 Tamils and Technology (1-0 -0 -1)	22PHL21 Physics Laboratory for Electronics and Communication Engineering (0-0-2-1)	22MEL11 Engineering Practices Laboratory (0-0-2-1)	22VEC11 Yoga and Values for Holistic Education (- - -- 1)	25
III	22MAT34 Transforms and Probability Theory (3-1-0-4)	22ITC31 Java Programming (3-0-2-4)	22ECT31 Digital Electronics (3-0-0-3)	22ECT32 Electronic Circuits (3-0-0-3)	22ECC31 Linear Integrated Circuits (3-0-2-4)	22GET31 Universal Human Values (2-0-0-2)	22TAM01 Heritage of Tamils (1-0-0-1)	22ECL31 Digital Electronics Laboratory (0-0-2-1)	22ECL32 Electronic Circuits Laboratory (0-0-2-1)		23
IV	22ITC41 Programming In Python (3-0-2-4)	22ECT41 Digital Signal Processing (3-1-0-4)	22ECT42 Microprocessor and Microcontroller (3-0-0-3)	22ECT43 Transmission Lines and Waveguides (3-0-0-3)	22ECT44 Control Engineering (3-1-0-4)	22ECL41 Digital Signal Processing Laboratory (0-0-2-1)	22ECL42 Microprocessor and Microcontroller Laboratory (0-0-2-1)	22EGL311 Communication Skills Development Laboratory (0-0-2-1)	22GEL41 Professional Skills Training I (2-0 -0 -2)		23
V	22ECT51 VLSI Design (3-0-0-3)	22ECT52 Analog and Digital Communication (3-0-0-3)	22ECC51 Embedded Systems and IoT (3-0-2-4)	22ECC52 Antennas and Wave Propagation (2-0-2-3)	Professional Elective I (3/2-0-0/2-3)	Open Elective – I (3-1/0-0/2-4)	22ECL51 VLSI Design Laboratory (0-0-2-1)	22ECL52 Analog and Digital Communication Laboratory (0-0-2-1)	22GEL51 Professional Skills Training II (2-0 -0 -2)		24
VI	22ECT61 Microwave and Optical Communication (3-0-0-3)	22ECT62 Data Communication and Networking (3-0-0-3)	Professional Elective II (3/2-0-0/2-3)	Open Elective –II (3-1/0-0/2-4)	22ECL61 Microwave and Optical Communication Laboratory (0-0-2-1)	22ECL62 Data Communication and networking Laboratory (0-0-2-1)	22ECP61 Project Work I (0-0-4-2)	22MNT31 Environmental Science (2-0-0-0)	22GEP61 Comprehensive Test and Viva (2-0-0-2)		21
VII	22GET71 Engineering Economics and Management (3-0-0-3)	Professional Elective III (3/2-0-0/2-3)	Professional Elective IV (3/2-0-0/2-3)	Professional Elective V (3/2-0-0/2-3)	Open Elective III (3-0-0-3)	Project Work II Phase I (0-0-8-4)					20
VIII	Professional Elective VI (3-0-0-3)	Open Elective IV (3-0-0-3)	22ECP81 Project Work II Phase II (0-0-14-7)								10

MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	22EGT11	Communication Skills I						✓			✓	✓		✓		
1	22MAC11	Matrices and Ordinary Differential Equations	✓	✓	✓		✓									
1	22CYT11	Chemistry for Electronics and Communication Engineering	✓	✓					✓						✓	✓
1	22ECT11	Circuits and Networks	✓	✓	✓									✓	✓	✓
1	22CSC11	Problem Solving and Programming in C	✓	✓	✓	✓										
1	22ECT12	Basics of Electrical and Electronics Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
1	22ECL11	Basics of Electronics and Electrical Engineering Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
1	22CYL11	Chemistry Laboratory For Electrical Systems	✓	✓		✓			✓						✓	✓
1	22GCL12	Foundation Engineering Laboratory II	✓	✓	✓											
2	22EGT21	Communication Skills II						✓			✓	✓		✓		
2	22MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	22PHT21	Physics for Electronics and Communication Engineering	✓	✓	✓						✓	✓		✓	✓	✓
2	22ECT21	Electromagnetic Fields	✓	✓			✓				✓	✓			✓	
2	22CSC21	Data Structures using C	✓	✓												
2	22MET11	Engineering Drawing	✓	✓			✓					✓		✓	✓	✓
2	22TAM02	Tamils and Technology						✓		✓	✓	✓		✓		
2	22PHL21	Physics Laboratory for Electronics and Communication Engineering	✓	✓	✓	✓					✓	✓		✓	✓	
2	22MEL11	Engineering Practices Laboratory	✓		✓	✓	✓				✓	✓		✓	✓	✓
2	22GCL11	Foundation Engineering Laboratory I	✓	✓	✓		✓				✓	✓		✓		
2	22VEC11	Yoga and Values for Holistic Education						✓		✓	✓					
3	22MAT33	Transforms and Probability theory	✓	✓	✓		✓	✓							✓	

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	22ITC31	Java Programming	✓	✓												
3	22ECT31	Digital Electronics	✓	✓	✓	✓	✓				✓			✓	✓	✓
3	22ECT32	Electronic Circuits	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	
3	22ECC31	Linear Integrated Circuits	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
3	22GET31	Universal Human Values	✓	✓												
3	22TAM01	Heritage of Tamils						✓		✓	✓	✓		✓		
3	22ECL31	Digital Electronics Laboratory	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓
3	22ECL32	Electronic Circuits Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
4	22ITC41	Programming In Python	✓	✓												
4	22ECT43	Transmission Lines and Waveguides	✓	✓	✓	✓				✓					✓	✓
4	22ECT44	Control Engineering	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓
4	22ECT41	Digital Signal Processing	✓	✓	✓	✓	✓				✓	✓		✓	✓	
4	22ECT42	Microprocessor and Microcontroller	✓	✓				✓				✓		✓	✓	✓
4	22ECL41	Digital Signal Processing Laboratory	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓
4	22ECL42	Microprocessor and Microcontroller Laboratory	✓	✓							✓	✓		✓	✓	
4	22EGL31	Communication Skills Development Laboratory									✓	✓		✓		
4	22GCL41	Professional Skills Training - I	✓	✓				✓	✓		✓	✓	✓	✓		
5	22ECT51	VLSI Design	✓	✓	✓		✓				✓			✓	✓	✓
5	22ECT52	Analog and Digital Communication	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
5	22ECC51	Embedded Systems and IoT	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓
5	22ECC52	Antennas and Wave Propagation	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓
5	22ECL51	VLSI Design Laboratory	✓	✓	✓	✓	✓				✓			✓	✓	✓
5	22ECL52	Analog and Digital Communication Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	
5	22GEL51	Professional Skills Training - II	✓	✓				✓	✓		✓	✓	✓	✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22ECT61	Microwave and Optical Communication	✓	✓	✓		✓	✓		✓			✓	✓	✓	✓
6	22ECT62	Data Communication and Networking	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓
6	22ECL61	Microwave and Optical Communication Laboratory	✓	✓	✓		✓				✓		✓	✓	✓	✓
6	22ECL62	Data Communication and Networking Laboratory	✓	✓	✓	✓		✓			✓	✓		✓	✓	
6	22ECP61	Project Work I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	22MNT31	Environmental Science	✓	✓					✓							
7	22GCT71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	22ECP71	Project Work II Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	22ECP81	Project Work II Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Electives														
5	22ECF01	Modern Electronic Instrumentation	✓	✓		✓	✓				✓	✓		✓	✓	✓
5	22ECE01	Medical Electronics	✓	✓	✓			✓		✓	✓			✓	✓	
5	22ECE02	Computer Architecture and Interfacing	✓	✓	✓	✓	✓							✓	✓	✓
5	22ECE03	Embedded System Design	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
5	22ECF02	Digital Image Processing and its Applications	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	22ECF03	Artificial Intelligence and Machine Learning	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	
5	22ECF04	Linux Operating System	✓	✓	✓		✓									
5	22ECE04	Data Science for Engineers	✓	✓	✓	✓	✓						✓	✓	✓	✓
6	22ECE05	Mobile Communication	✓	✓	✓	✓	✓							✓	✓	
6	22ECE06	Embedded Architecture and Standards	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
6	22ECF05	Electronics Circuit Board Design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
6	22ECF06	Single Board Computer	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
6	22ECF07	ASIC Design	✓	✓	✓		✓				✓	✓		✓	✓	✓
6	22ECF08	Soft Computing Techniques	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22ECF09	DSP Processor and its Applications	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	
6	22ECF10	Deep Learning and its Applications	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
7	22ECE07	Wireless Broadband Communication	✓	✓	✓	✓	✓					✓	✓	✓	✓	
7	22ECE08	Network Information Security	✓	✓	✓	✓				✓					✓	
7	22ECE09	Real Time Operating System	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
7	22ECF11	Scripting languages for VLSI	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓
7	22ECE10	Quantum Computing and Information	✓	✓	✓									✓	✓	
7	22ECF12	Wavelet Transform and its Applications	✓	✓	✓	✓	✓				✓	✓			✓	
7	22ECF13	Computer Vision	✓	✓	✓	✓	✓				✓			✓	✓	✓
7	22ECE11	Edge Computing	✓	✓	✓		✓			✓	✓					
7	22ECE12	Satellite Communication	✓	✓	✓	✓		✓		✓				✓	✓	✓
7	22ECE13	Wireless Networks	✓	✓	✓	✓	✓	✓								
7	22ECE14	RISC Architecture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	22ECE15	System Verilog	✓		✓									✓	✓	✓
7	22ECE16	Neural Science for Engineers	✓	✓	✓	✓	✓	✓		✓				✓		✓
7	22ECE17	Remote Sensing	✓	✓			✓	✓	✓	✓	✓			✓	✓	✓
7	22ECE18	Natural Language Processing	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓
7	22ECE19	Blockchain Technology	✓	✓	✓	✓								✓	✓	
7	22ECE20	Next Generation Wireless Communication Systems	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	
7	22ECE21	Radar Engineering	✓	✓	✓	✓		✓	✓	✓				✓	✓	✓
7	22ECE22	Automotive Electronic Systems	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
7	22ECE23	Wireless Sensor Networks	✓	✓	✓	✓				✓	✓		✓	✓	✓	✓
7	22ECE24	Industry 4.0	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓
7	22ECE25	Testing and Fault Diagnosis of VLSI Circuits	✓	✓	✓									✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	22ECE26	MEMS Design	✓	✓	✓	✓	✓							✓	✓	
7	22ECE27	Software Quality Assurance and Testing	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓
8	22ECE28	Software Defined Radio	✓	✓	✓		✓		✓	✓	✓	✓			✓	✓
8	22ECE29	RF Communications	✓	✓	✓	✓				✓		✓	✓	✓	✓	
8	22ECF14	Wearable Technology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	22ECE30	Cyber Physical Systems	✓	✓	✓	✓		✓		✓					✓	✓
8	22ECE31	NanoTechnology For Energy Sustainability	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	
8	22ECE32	Low Power VLSI Design	✓	✓	✓									✓	✓	✓
8	22ECE33	Brain Computer Interface and Applications	✓	✓	✓	✓	✓			✓				✓	✓	✓
5	22ECX01	Basics of Electronics in Automation Appliances	✓	✓	✓	✓		✓	✓	✓			✓	✓		
6	22ECX02	Image Processing	✓	✓	✓	✓	✓				✓	✓		✓		
6	22ECX03	PCB Design and Fabrication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
7	22ECO01	Wearable Devices	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		
7	22ECX04	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
8	22ECO02	Optical Engineering	✓	✓	✓	✓		✓		✓	✓			✓		
		Open Elective Courses														
5	22CEX01	Remote Sensing and its Applications	✓	✓	✓	✓		✓			✓			✓		
5	22MEX01	Renewable Energy Sources	✓		✓	✓	✓	✓	✓	✓	✓					
5	22MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
5	22MTX01	Data Acquisition and Virtual Instrumentation	✓	✓	✓	✓	✓							✓		
5	22MTX02	Factory Automation	✓	✓	✓	✓	✓				✓	✓		✓		
5	22AUX01	Automotive Engineering	✓	✓	✓			✓	✓		✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22ECX01	Basics of Electronics in Automation Appliances	✓	✓	✓	✓		✓	✓	✓			✓	✓		
5	22ECX02	Image Processing	✓	✓	✓	✓	✓				✓	✓		✓		
5	22EEO01	Solar and Wind Energy Systems	✓	✓	✓			✓	✓					✓		
5	22EEO02	Electrical Wiring and Lighting	✓	✓	✓	✓	✓							✓		
5	22EEO03	Programmable Logic Controller and SCADA	✓	✓	✓	✓		✓			✓			✓		
5	22EEO04	Analog and Digital Electronics	✓	✓	✓	✓	✓							✓		
5	22EEO05	Power Electronics and Drives	✓	✓	✓	✓	✓	✓			✓					
5	22EEO06	Sensors and Actuators	✓	✓	✓			✓						✓		
5	22EIO01	Measurements and Instrumentation	✓	✓	✓	✓	✓									
5	22EIO02	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓		✓						
5	22EIO03	Industrial Automation	✓	✓	✓	✓	✓									
5	22CSX01	Fundamentals of Databases	✓	✓	✓											
5	22CSX02	Data science for Engineers	✓	✓	✓	✓	✓									
5	22CSX03	Enterprise Application Development Using Java	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
5	22CSO01	Computational science for Engineers	✓	✓	✓											
5	22CSO02	Formal Languages and Automata Theory	✓	✓	✓											
5	22ITO01	Artificial Intelligence	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
5	22ITX01	Next Generation Databases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
5	22CDO01	Fundamentals of User Experience Design	✓	✓	✓	✓	✓				✓	✓	✓			
5	22ADO01	Data Warehousing and Data Mining	✓	✓	✓											
5	22ALO01	Business Intelligence	✓	✓	✓											
5	22CHO01	Industrial Enzymology	✓	✓	✓							✓	✓	✓		
5	22CHO02	Waste to Energy Conversion	✓	✓												
5	22CHO03	Applied Nanotechnology	✓	✓	✓	✓	✓	✓	✓	✓				✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22FTX01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
5	22FTO01	Food Processing Technology	✓	✓	✓	✓		✓				✓		✓		
5	22MAO01	Mathematical Foundations for Machine Learning	✓	✓	✓	✓	✓									
5	22MAO02	Numerical Computing	✓	✓	✓											
5	22MAO03	Stochastic Processes and Queuing Theory	✓	✓	✓											
5	22MAO04	Statistics for Engineers	✓	✓	✓											
5	22PHO01	Thin Film Technology	✓	✓	✓						✓	✓		✓		
5	22PHO02	High Energy Storage Devices	✓	✓	✓						✓	✓		✓		
5	22PHO03	Structural and Optical Characterization of Materials	✓	✓	✓						✓	✓		✓		
5	22CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										
5	22CYO02	Chemistry Concepts for Competitive Examinations	✓	✓	✓											
5	22CYO03	Organic Chemistry for Industry	✓	✓	✓	✓										
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22CEO01	Disaster Management	✓	✓	✓			✓	✓					✓		
6	22MEX02	Design of Experiments	✓	✓	✓	✓	✓				✓					
6	22GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
6	22MTO02	Robotics	✓	✓	✓	✓	✓							✓		
6	22MTO03	3D Printing and Design	✓	✓			✓							✓		
6	22AUO01	Automotive Electronics	✓	✓	✓	✓								✓		
6	22ECX03	PCB Design and Fabrication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
6	22EEO07	Energy Conservation and Management	✓	✓	✓		✓		✓	✓	✓			✓		
6	22EEO08	Microprocessors and Microcontrollers Interfacing	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
6	22EEO09	Electrical Safety	✓	✓	✓				✓	✓			✓	✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22EEO10	VLSI System Design	✓	✓	✓	✓	✓				✓		✓	✓		
6	22EEO11	Automation for Industrial Applications	✓	✓	✓	✓			✓		✓			✓		
6	22EIO04	PLC Programming with High Level Languages	✓	✓	✓	✓	✓									
6	22EIO05	Virtual Instrumentation	✓	✓	✓	✓	✓									
6	22CSX04	Foundations of Machine Learning	✓	✓	✓											
6	22CSX05	Web Engineering	✓	✓	✓											
6	22ITX02	Advanced Java Programming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
6	22ITO02	Internet of Things	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
6	22ITO03	Fundamentals of Software Development	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
6	22ITO04	Mobile Application Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
6	22CDX01	Fundamentals of User Interactive Design	✓	✓	✓	✓										
6	22ADX01	Data Visualization	✓	✓	✓											
6	22ALX01	Data Exploration and Visualization Techniques	✓	✓	✓											
6	22CHO04	Air Pollution Monitoring and Control	✓	✓	✓			✓	✓							
6	22CHO05	Paints and Coatings	✓	✓	✓				✓							
6	22CHO06	Powder Technology	✓	✓	✓			✓	✓					✓		
6	22FTX02	Processing of milk and milk products	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	22FTX03	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	22MAO05	Graph Theory and its Applications	✓	✓	✓											
6	22MAX01	Data Analytics using R Programming	✓	✓	✓	✓	✓									
6	22MAO06	Operations Research	✓	✓	✓											
6	22MAO07	Number Theory and Cryptography	✓	✓	✓		✓									
6	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	✓	✓	✓						✓	✓		✓		
6	22PHO05	Techniques of Crystal Growth	✓	✓	✓						✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22CYO04	Corrosion Science and Engineering	✓	✓	✓	✓										
6	22CYO05	Chemistry of Cosmetics in Daily Life	✓	✓	✓											
6	22CYO06	Nanocomposite Materials	✓	✓	✓	✓										
6	22MBO02	Economic Analysis for Decision Making					✓					✓	✓			
7	22CEO02	Introduction to Smart Cities	✓	✓	✓	✓	✓									
7	22CEO03	Environmental Health and Safety	✓	✓	✓			✓	✓							
7	22MEO01	Fundamentals of Ergonomics	✓	✓	✓	✓	✓	✓	✓					✓		
7	22MEO02	Principles of Management and Industrial Psychology	✓					✓				✓	✓			
7	22MEO03	Waste Heat Recovery System and Storage	✓	✓	✓	✓			✓							
7	22GEO05	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
7	22MTO04	Drone System Technology	✓	✓	✓	✓	✓							✓		
7	22AUO02	Vehicle Maintenance	✓	✓			✓		✓					✓		
7	22ECO01	Wearable Devices	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		
7	22ECX04	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
7	22EEO12	Electric Vehicle	✓	✓	✓	✓		✓	✓		✓			✓		
7	22EEO13	E-Waste Management	✓	✓	✓	✓		✓	✓					✓		
7	22EEO14	Embedded System Design	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
7	22EEO15	Energy Storage Systems and Controllers	✓	✓	✓			✓			✓		✓	✓		
7	22EEO16	AI Techniques for Engineering Applications	✓	✓	✓	✓										
7	22EIO06	Introduction to Distributed Control Systems	✓	✓	✓	✓	✓			✓		✓				
7	22EIO07	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓									
7	22EIO08	Industry 4.0 with Industrial IoT	✓	✓	✓	✓	✓			✓						
7	22EIO09	Industrial Data Communication	✓	✓	✓	✓	✓	✓								
7	22EIO10	Wireless Instrumentation	✓	✓	✓	✓	✓		✓							

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	22EIO11	Instrumentation Techniques in Agriculture	✓	✓	✓	✓	✓									
7	22CSO03	Nature Inspired optimization techniques	✓	✓	✓											
7	22ITO05	Fundamentals of Cloud Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22ITO06	Introduction to Ethical Hacking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22CDO02	Introduction to Mobile Game Design	✓	✓	✓	✓										
7	22CDO03	Introduction to Graphics Design	✓	✓	✓	✓										
7	22ADO02	Neural Networks and Deep Learning	✓	✓	✓	✓										
7	22ALO02	Industrial Machine Learning	✓	✓	✓											
7	22CHO07	Hydrogen Energy	✓	✓										✓		
7	22CHO08	Rubber Technology	✓	✓				✓	✓					✓		
7	22FTO02	Principles of Food safety	✓	✓	✓			✓	✓	✓		✓		✓		
7	22FTO03	Fundamentals of Food Packaging and Storage	✓	✓	✓	✓	✓	✓		✓		✓		✓		
7	22MAO08	Non-Linear Optimization	✓	✓	✓											
7	22MAO09	Optimization for Engineers	✓	✓	✓											
7	22CYO07	Waste and Hazardous Waste Management	✓	✓	✓	✓			✓							
7	22CYO08	Chemistry in Every day Life	✓	✓	✓	✓										
7	22MBO03	Marketing Analytics										✓	✓	✓		
8	22CEO04	Infrastructure Planning and Management	✓	✓	✓		✓									
8	22CEO05	Environmental Laws and Policy	✓	✓			✓									
8	22MEO04	Safety Measures for Engineers	✓					✓	✓	✓						
8	22MEO05	Energy Conservation in Thermal Equipments	✓		✓		✓	✓	✓					✓		
8	22MEO06	Climate Change and New Energy Technology	✓		✓			✓	✓	✓						
8	22MTO05	Micro and Nano Electromechanical Systems	✓	✓	✓	✓								✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	22AUO03	Public Transport Management	✓	✓				✓	✓	✓				✓		
8	22AUO04	Autonomous Vehicles	✓	✓	✓	✓	✓	✓	✓					✓		
8	22ECO02	Optical Engineering	✓	✓	✓	✓		✓	✓	✓	✓			✓		
8	22EEO17	Smart Grid Technologies	✓	✓	✓	✓	✓			✓				✓		
8	22EEO18	Biomass Energy Systems	✓	✓	✓			✓	✓				✓	✓		
8	22EIO12	Environmental Sensors	✓	✓	✓	✓	✓		✓							
8	22EIO13	Pollution Control and Management	✓	✓	✓	✓	✓	✓		✓						
8	22CSO04	Machine Translation	✓	✓	✓											
8	22CSO05	Fundamentals of Blockchain	✓	✓	✓											
8	22ITO07	Business Continuity Planning	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
8	22CDX02	Virtual Reality and Augmented Reality	✓	✓	✓	✓										
8	22ADO03	Business Analytics	✓	✓	✓	✓										
8	22ALO03	Machine Learning for Smart Cities	✓	✓	✓	✓										
8	22CHO09	Industrial Accident Prevention and Management	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓		
8	22CHO10	Electrochemical Engineering	✓	✓	✓											
8	22CHO11	Smart and Functional Materials	✓	✓					✓	✓	✓			✓		
8	22FTO04	Food Ingredients	✓	✓	✓			✓		✓		✓		✓		
8	22FTO05	Food and Nutrition	✓	✓	✓			✓				✓		✓		
8	22CYO09	Chemistry of Nutrition for Women Health	✓	✓	✓											
		General Open Elective Courses														
ALL	22GEO01	German Language Level 1								✓	✓	✓		✓		
ALL	22GEO02	Japanese Language Level 1								✓	✓	✓		✓		
5	22GEO03	Design Thinking for Engineers	✓	✓	✓	✓										
6	22GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ALL	22GEO05	German Language Level 2								✓	✓	✓		✓		
ALL	22GEO06	German Language Level 3								✓	✓	✓		✓		
ALL	22GEO07	German Language Level 4								✓	✓	✓		✓		
ALL	22GEO08	Japanese Language Level 2								✓	✓	✓		✓		
ALL	22GEO09	Japanese Language Level 3								✓	✓	✓		✓		
ALL	22GEO10	Japanese Language Level 4								✓	✓	✓		✓		
ALL	22GEO11	French Language Level 1								✓	✓	✓		✓		
ALL	22GEO12	French Language Level 2								✓	✓	✓		✓		
ALL	22GEO13	French Language Level 3								✓	✓	✓		✓		
ALL	22GEO14	Spanish Language Level 1								✓	✓	✓		✓		
ALL	22GEO15	Spanish Language Level 2								✓	✓	✓		✓		
ALL	22GEO16	Spanish Language Level 3								✓	✓	✓		✓		
7	22GEO17	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
5 / 6	22GEX01	NCC Studies (Army Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5 / 6	22GEX02	NCC Studies (Air Wing) - 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22MBO02	Economic Analysis for Decision Making					✓					✓	✓			
7	22MBO03	Marketing Analytics										✓	✓	✓		

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2022-23)

SEMESTER – I									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EGT11	Communication Skills –I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	50	50	100	BS
22CYT11	Chemistry for Electronics and Communication Engineering	3	0	0	3	40	60	100	BS
22ECT11	Circuits and Networks	3	0	0	3	40	60	100	PC
22CSC11	Problem Solving and Programming in C	3	0	2	4	100	0	100	ES
22ECT12	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100	ES
Practical / Employability Enhancement									
22ECL11	Basics of Electrical and Electronics Engineering Laboratory	0	0	2	1	60	40	100	ES
22CYL11	Chemistry Laboratory For Electrical Systems	0	0	2	1	60	40	100	BS
22MNT11	Student Induction Program	---	---	---	0	100	0	100	MC
Total Credits to be earned					22				

*Alternate weeks

SEMESTER – II									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EGT21	Communication Skills –II	3	0	0	3	40	60	100	HS
22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
22PHT21	Physics for Electronics and Communication Engineering	3	0	0	3	40	60	100	BS
22ECT21	Electromagnetic fields	3	1	0	4	40	60	100	PC
22CSC22	Data Structures using C	3	0	2	4	50	50	100	ES
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22PHL21	Physics Laboratory for Electronics and Communication Engineering	0	0	2	1	60	40	100	BS
22MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
22VEC11	Yoga and Values for Holistic Education	--	--	--	1	100	0	100	HS
Total Credits to be earned					25				

*Alternate weeks

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2022-23)

SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MAT33	Transforms and Probability Theory	3	1	0	4	40	60	100	BS
22ITC31	Java Programming	3	0	2	4	50	50	100	ES
22ECT31	Digital Electronics	3	0	0	3	40	60	100	PC
22ECT32	Electronic Circuits	3	0	0	3	40	60	100	PC
22ECC31	Linear Integrated Circuits	3	0	2	4	50	50	100	PC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22ECL31	Digital Electronics Laboratory	0	0	2	1	60	40	100	PC
22ECL32	Electronic Circuits Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					23				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ITC41	Programming In Python	3	0	2	4	50	50	100	ES
22ECT41	Digital Signal Processing	3	1	0	4	40	60	100	PC
22ECT42	Microprocessor and Microcontroller	3	0	0	3	40	60	100	PC
22ECT43	Transmission Lines and Waveguides	3	0	0	3	40	60	100	PC
22ECT44	Control Engineering	3	1	0	4	40	60	100	PC
Practical / Employability Enhancement									
22ECL41	Digital Signal Processing Laboratory	0	0	2	1	60	40	100	PC
22ECL42	Microprocessor and Microcontroller Laboratory	0	0	2	1	60	40	100	PC
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
22GEL41	Professional Skills Training I	2	0	0	2	100	0	100	EC
Total Credits to be earned					23				

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2022-23)

SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ECT51	VLSI Design	3	0	0	3	40	60	100	PC
22ECT52	Analog and Digital Communication	3	0	0	3	40	60	100	PC
22ECC51	Embedded Systems and IoT	3	0	2	4	50	50	100	PC
22ECC52	Antennas and Wave Propagation	2	0	2	3	50	50	100	PC
	Professional Elective - I	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Open Elective – II	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22ECL51	VLSI Design Laboratory	0	0	2	1	60	40	100	PC
22ECL52	Analog and Digital Communication Laboratory	0	0	2	1	60	40	100	PC
22GEL51	Professional Skills Training II	2	0	0	2	100	0	100	EC
Total Credits to be earned					24				

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ECT61	Microwave and Optical Communication	3	0	0	3	40	60	100	PC
22ECT62	Data Communication and Networking	3	0	0	3	40	60	100	PC
	Professional Elective - II	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Open Elective - II	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22ECL61	Microwave and Optical Communication Laboratory	0	0	2	1	60	40	100	PC
22ECL62	Data Communication and Networking Laboratory	0	0	2	1	60	40	100	PC
22ECP61	Project Work I	0	0	8	4	50	50	100	EC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
22GEP61	Comprehensive Test and Viva	2	0	0	2	100	0	100	EC
Total Credits to be earned					21				

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2022-23)

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
	Professional Elective – III	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Professional Elective – IV	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Professional Elective – V	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Open Elective - III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ECP71	Project Work II Phase I	0	0	10	5	50	50	100	EC
Total Credits to be earned					20				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Professional Elective - VI	3	0	0	3	40	60	100	PE
	Open Elective - IV	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ECP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					10				

Total Credits : 168

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2022-23)

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester - V							
Elective – I							
1.	22ECF01	Modern Electronic Instrumentation	2	0	2	3	EL
2.	22ECE01	Medical Electronics	3	0	0	3	EL
3.	22ECE02	Computer Architecture and Interfacing	3	0	0	3	EL
4.	22ECE03	Embedded System Design	3	0	0	3	ES
5.	22ECF02	Digital Image Processing and its Applications	2	0	2	3	SIP
6.	22ECF03	Artificial Intelligence and Machine Learning	2	0	2	3	SIP
7.	22ECF04	Linux Operating System	2	0	2	3	SD
8.	22ECE04	Data Science for Engineers	3	0	0	3	SD
Semester - VI							
Elective – II							
9.	22ECE05	Mobile Communication	3	0	0	3	CN
10.	22ECE06	Embedded Architecture and Standards	3	0	0	3	ES
11.	22ECF05	Electronics Circuit Board Design	2	0	2	3	EL
12.	22ECF06	Single Board Computer	2	0	2	3	ES
13.	22ECF07	ASIC Design	2	0	2	3	VD
14.	22ECF08	Soft Computing Techniques	2	0	2	3	SIP
15.	22ECF09	DSP Processor and its Applications	2	0	2	3	SIP
16.	22ECF10	Deep Learning and its Applications	2	0	2	3	SIP
Semester - VII							
Elective - III							
17.	22ECE07	Wireless Broadband Communication	3	0	0	3	CN
18.	22ECE08	Network Information Security	3	0	0	3	CN
19.	22ECE09	Real Time Operating System	3	0	0	3	ES
20.	22ECF11	Scripting languages for VLSI	2	0	2	3	VD
21.	22ECE10	Quantum Computing and Information	3	0	0	3	VD
22.	22ECF12	Wavelet Transform and its Applications	2	0	2	3	SIP
23.	22ECF13	Computer Vision	2	0	2	3	SIP

24.	22ECE11	Edge Computing	3	0	0	3	SD
Elective – IV							
25.	22ECE12	Satellite Communication	3	0	0	3	CN
26.	22ECE13	Wireless Networks	3	0	0	3	CN
27.	22ECE14	RISC Architecture	3	0	0	3	ES
28.	22ECE15	System Verilog	3	0	0	3	VD
29.	22ECE16	Neural Science for Engineers	3	0	0	3	SIP
30.	22ECE17	Remote Sensing	3	0	0	3	SIP
31.	22ECE18	Natural Language Processing	3	0	0	3	SIP
32.	22ECE19	Blockchain Technology	3	0	0	3	SD
Elective - V							
33.	22ECE20	Next Generation Wireless Communication Systems	3	0	0	3	CN
34.	22ECE21	Radar Engineering	3	0	0	3	CN
35.	22ECE22	Automotive Electronic Systems	3	0	0	3	EL
36.	22ECE23	Wireless Sensor Networks	3	0	0	3	ES
37.	22ECE24	Industry 4.0	3	0	0	3	ES
38.	22ECE25	Testing and Fault Diagnosis of VLSI Circuits	3	0	0	3	VD
39.	22ECE26	MEMS Design	3	0	0	3	VD
40.	22ECE27	Software Quality Assurance and Testing	3	0	0	3	SD
Semester - VIII							
Elective - VI							
41.	22ECE28	Software Defined Radio	3	0	0	3	CN
42.	22ECE29	RF Communications	3	0	0	3	CN
43.	22ECF14	Wearable Technology	2	0	2	3	ES
44.	22ECE30	Cyber Physical Systems	3	0	0	3	ES
45.	22ECE31	Nano Technology For Energy Sustainability	0	0	0	3	VD
46.	22ECE32	Low Power VLSI Design	3	0	0	3	VD
47.	22ECE33	Brain Computer Interface and Applications	3	0	0	3	SIP
Total Credits to be earned						**18**	

***** Domain/Stream Abbreviations: : EL – Electronics, VD- VLSI Design, CN- Communication & Networks, SIP – Signal & Image Processing, ES – Embedded Systems, SD – Software Development

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2023-24)

SEMESTER – I									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EGT11	Communication Skills –I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	50	50	100	BS
22CYT11	Chemistry for Electronics and Communication Engineering	3	0	0	3	40	60	100	BS
22ECT11	Circuits and Networks	3	0	0	3	40	60	100	PC
22CSC11	Problem Solving and Programming in C	3	0	2	4	100	0	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22GCL12	Foundation Laboartary – Electrical, IOT and Web	0	0	6	3	100	0	100	ES
22CYL11	Chemistry Laboratory For Electrical Systems	0	0	2	1	60	40	100	BS
22MNT11	Student Induction Program	---	---	---	0	100	0	100	MC
Total Credits to be earned					22				

*Alternate weeks

SEMESTER – II									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EGT21	Communication Skills –II	3	0	0	3	40	60	100	HS
22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
22PHT21	Physics for Electronics and Communication Engineering	3	0	0	3	40	60	100	BS
22CSC22	Data Structures using C	3	0	2	4	50	50	100	ES
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22PHL21	Physics Laboratory for Electronics and Communication Engineering	0	0	2	1	60	40	100	BS
22GCL11	Foundation Laboratory – Manufacturing, Design and Robotics	0	0	6	3	100	0	100	ES
22VEC11	Yoga and Values for Holistic Education	--	--	--	1	100	0	100	HS
Total Credits to be earned					23				

*Alternate weeks

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2023-24)

SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MAT33	Transforms and Probability Theory	3	1	0	4	40	60	100	BS
22ITC31	Java Programming	3	0	2	4	50	50	100	ES
22ECT31	Digital Electronics	3	0	0	3	40	60	100	PC
22ECT32	Electronic Circuits	3	0	0	3	40	60	100	PC
22ECT21	Electromagnetic fields	3	1	0	4	40	60	100	PC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Practical / Employability Enhancement									
22ECL31	Digital Electronics Laboratory	0	0	2	1	60	40	100	PC
22ECL32	Electronic Circuits Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					22				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ITC41	Programming In Python	3	0	2	4	50	50	100	ES
22ECT41	Digital Signal Processing	3	1	0	4	40	60	100	PC
22ECT42	Microprocessor and Microcontroller	3	0	0	3	40	60	100	PC
22ECT43	Transmission Lines and Waveguides	3	0	0	3	40	60	100	PC
22ECC31	Linear Integrated Circuits	3	0	2	4	50	50	100	PC
Practical / Employability Enhancement									
22ECL41	Digital Signal Processing Laboratory	0	0	2	1	60	40	100	PC
22ECL42	Microprocessor and Microcontroller Laboratory	0	0	2	1	60	40	100	PC
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
22GEL41	Professional Skills Training I	0	0	0	2	100	0	100	EC
Total Credits to be earned					23				

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2023-24)

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22ECT51	VLSI Design	3	0	0	3	40	60	100	PC
22ECT52	Analog and Digital Communication	3	0	0	3	40	60	100	PC
22ECC51	Embedded Systems and IoT	3	0	2	4	50	50	100	PC
22ECT44	Control Engineering	3	1	0	4	40	60	100	PC
	Professional Elective - I	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Open Elective – I	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22ECL51	VLSI Design Laboratory	0	0	2	1	60	40	100	PC
22ECL52	Analog and Digital Communication Laboratory	0	0	2	1	60	40	100	PC
22GEL51	Professional Skills Training II	0	0	0	2	100	0	100	EC
Total Credits to be earned					25				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22ECT61	Microwave and Optical Communication	3	0	0	3	40	60	100	PC
22ECT62	Data Communication and Networking	3	0	0	3	40	60	100	PC
	Professional Elective - II	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Open Elective - II	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22ECL61	Microwave and Optical Communication Laboratory	0	0	2	1	60	40	100	PC
22ECL62	Data Communication and Networking Laboratory	0	0	2	1	60	40	100	PC
22ECP62	Project Work I	0	0	10	5	50	50	100	EC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
22GEP61	Comprehensive Test and Viva	2	0	0	2	100	0	100	EC
Total Credits to be earned					22				

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2023-24)

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
22ECC52	Antennas and Wave Propagation	2	0	2	3	50	50	100	PC
	Professional Elective – III	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Professional Elective – IV	3/2	0	0/2	3	40/ 50	60/ 50	100	PE
	Open Elective - III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ECP72	Project Work II Phase I	0	0	12	6	50	50	100	EC
Total Credits to be earned					21				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Professional Elective - V	3	0	0	3	40	60	100	PE
	Open Elective - IV	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ECP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					10				

Total Credits : 168

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM UNDER REGULATIONS 2022
(For the candidates admitted in the academic year 2023-24)

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester - V							
Elective – I							
1.	22ECF01	Modern Electronic Instrumentation	2	0	2	3	EL
2.	22ECE01	Medical Electronics	3	0	0	3	EL
3.	22ECE02	Computer Architecture and Interfacing	3	0	0	3	EL
4.	22ECE03	Embedded System Design	3	0	0	3	ES
5.	22ECF02	Digital Image Processing and its Applications	2	0	2	3	SIP
6.	22ECF03	Artificial Intelligence and Machine Learning	2	0	2	3	SIP
7.	22ECF04	Linux Operating System	2	0	2	3	SD
8.	22ECE04	Data Science for Engineers	3	0	0	3	SD
Semester - VI							
Elective – II							
9.	22ECE05	Mobile Communication	3	0	0	3	CN
10.	22ECE06	Embedded Architecture and Standards	3	0	0	3	ES
11.	22ECF05	Electronics Circuit Board Design	2	0	2	3	EL
12.	22ECF06	Single Board Computer	2	0	2	3	ES
13.	22ECF07	ASIC Design	2	0	2	3	VD
14.	22ECF08	Soft Computing Techniques	2	0	2	3	SIP
15.	22ECF09	DSP Processor and its Applications	2	0	2	3	SIP
16.	22ECF10	Deep Learning and its Applications	2	0	2	3	SIP
Semester - VII							
Elective - III							
17.	22ECE07	Wireless Broadband Communication	3	0	0	3	CN
18.	22ECE08	Network Information Security	3	0	0	3	CN
19.	22ECE09	Real Time Operating System	3	0	0	3	ES
20.	22ECF11	Scripting languages for VLSI	2	0	2	3	VD
21.	22ECE10	Quantum Computing and Information	3	0	0	3	VD

22.	22ECF12	Wavelet Transform and its Applications	2	0	2	3	SIP
23.	22ECF13	Computer Vision	2	0	2	3	SIP
24.	22ECE11	Edge Computing	3	0	0	3	SD
Elective – IV							
25.	22ECE12	Satellite Communication	3	0	0	3	CN
26.	22ECE13	Wireless Networks	3	0	0	3	CN
27.	22ECE14	RISC Architecture	3	0	0	3	ES
28.	22ECE15	System Verilog	3	0	0	3	VD
29.	22ECE16	Neural Science for Engineers	3	0	0	3	SIP
30.	22ECE17	Remote Sensing	3	0	0	3	SIP
31.	22ECE18	Natural Language Processing	3	0	0	3	SIP
32.	22ECE19	Blockchain Technology	3	0	0	3	SD
33.	22ECE20	Next Generation Wireless Communication Systems	3	0	0	3	CN
34.	22ECE21	Radar Engineering	3	0	0	3	CN
35.	22ECE22	Automotive Electronic Systems	3	0	0	3	EL
36.	22ECE23	Wireless Sensor Networks	3	0	0	3	ES
37.	22ECE24	Industry 4.0	3	0	0	3	ES
38.	22ECE25	Testing and Fault Diagnosis of VLSI Circuits	3	0	0	3	VD
39.	22ECE26	MEMS Design	3	0	0	3	VD
40.	22ECE27	Software Quality Assurance and Testing	3	0	0	3	SD
41.	22ECE28	Software Defined Radio	3	0	0	3	CN
Semester - VIII							
Elective – V							
42.	22ECE29	RF Communications	3	0	0	3	CN
43.	22ECF14	Wearable Technology	2	0	2	3	ES
44.	22ECE30	Cyber Physical Systems	3	0	0	3	ES
45.	22ECE31	Nano Technology For Energy Sustainability	0	0	0	3	VD
46.	22ECE32	Low Power VLSI Design	3	0	0	3	VD
47.	22ECE33	Brain Computer Interface and Applications	3	0	0	3	SIP
Total Credits to be earned						**18**	

GENERAL OPEN ELECTIVE
(Common to All BE/BTech branches)

SNo	Course Code	Course Title	L	T	P	C	Offering Department	Semester
1.	22GEO01	German Language Level 1	4	0	0	4	ECE	ALL
2.	22GEO02	Japanese Language Level 1	4	0	0	4	ECE	ALL
3.	22GEO03	Design Thinking for Engineers	3	1	0	4	CSE	5
4.	22GEO04	Innovation and Business Model Development	3	1	0	4	MTS	6
5.	22GEO05	German Language Level 2	4	0	0	4	ECE	ALL
6.	22GEO06	German Language Level 3	3	0	0	3	ECE	ALL
7.	22GEO07	German Language Level 4	3	0	0	3	ECE	ALL
8.	22GEO08	Japanese Language Level 2	4	0	0	4	ECE	ALL
9.	22GEO09	Japanese Language Level 3	3	0	0	3	ECE	ALL
10.	22GEO10	Japanese Language Level 4	3	0	0	3	ECE	ALL
11.	22GEO11	French Language Level 1	4	0	0	4	ECE	ALL
12.	22GEO12	French Language Level 2	4	0	0	4	ECE	ALL
13.	22GEO13	French Language Level 3	3	0	0	3	ECE	ALL
14.	22GEO14	Spanish Language Level 1	4	0	0	4	ECE	ALL
15.	22GEO15	Spanish Language Level 2	4	0	0	4	ECE	ALL
16.	22GEO16	Spanish Language Level 3	3	0	0	3	ECE	ALL
17.	22GEO17	Entrepreneurship Development	3	0	0	3	MTS	7
18.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	EEE	5 / 6
19.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT	5 / 6
20.	22MBO01	Cost Accounting for Engineers	3	1	0	4	MBA	5
21.	22MBO02	Economic Analysis for Decision Making	3	1	0	4	MBA	6
22.	22MBO03	Marketing Analytics	3	1	0	4	MBA	7

LIST OF OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22ECX01	Basics of Electronics in Automation Appliances	3	0	2	4	V
2.	22ECX02	Image Processing	3	0	2	4	V
3.	22ECX03	PCB Design and Fabrication	3	0	2	4	VI
4.	22ECO01	Wearable Devices	3	0	0	3	VII
5.	22ECX04	Electronic Hardware and Troubleshooting	2	0	2	3	VII
6.	22ECO02	Optical Engineering	3	0	0	3	VIII

LIST OF OPEN ELECTIVE COURSES OFFERED UNDER R2022

S.No	Course Code	Course Title	L	T	P	C	Offering Dept.	Sem.
1	22CEX01	Remote Sensing and its Applications	3	0	2	4	Civil	5
2	22MEX01	Renewable Energy Sources	3	0	2	4	Mech	5
3	22MTO01	Design of Mechatronics Systems	3	1	0	4	MTS	5
4	22MTX01	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS	5
5	22MTX02	Factory Automation	3	0	2	4	MTS	5
6	22AUX01	Automotive Engineering	3	0	2	4	Auto	5
7	22AUO01	Automotive Electronics	3	1	0	4	Auto	5
8	22ECX01	Basics of Electronics in Automation Appliances	3	0	2	4	ECE	5
9	22ECX02	Image Processing	3	0	2	4	ECE	5
10	22EEO01	Solar and Wind Energy Systems	3	1	0	4	EEE	5
11	22EEO02	Electrical Wiring and Lighting	3	1	0	4	EEE	5
12	22EEO03	Electrical Safety	3	1	0	4	EEE	5
13	22EEO04	Analog and Digital Electronics	3	1	0	4	EEE	5
14	22EEO05	Power Electronics and Drives	3	1	0	4	EEE	5
15	22EEO06	Sensors and Actuators	3	1	0	4	EEE	5
16	22EIO01	Biomedical Instrumentation and Applications	3	1	0	4	EIE	5
17	22EIO02	Industrial Automation	3	1	0	4	EIE	5
18	22CSX01	Fundamentals of Databases	3	0	2	4	CSE	5
19	22CSX02	Data science for Engineers	3	0	2	4	CSE	5
20	22CSX03	Enterprise Application Development Using Java	3	0	2	4	CSE	5
21	22CSO01	Computational Science for Engineers	3	1	0	4	CSE	5
22	22CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE	5

23	22ITO01	Artificial Intelligence	3	1	0	4	IT	5
24	22ITX01	Next Generation Databases	3	0	2	4	IT	5
25	22CHO01	Industrial Enzymology	3	1	0	4	Chem	5
26	22CHO02	Waste to Energy Conversion	3	1	0	4	Chem	5
27	22CHO03	Applied Nanotechnology	3	1	0	4	Chem	5
28	22FTX01	Baking Technology	3	0	2	4	FT	5
29	22FTO01	Food Processing Technology	3	1	0	4	FT	5
30	22CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD	5
31	22ADO01	Data Warehousing and Data Mining	3	1	0	4	AI	5
32	22ALO01	Business Intelligence	3	1	0	4	AI	5
33	22MAO01	Mathematical Foundations of Machine Learning	3	1	0	4	Maths	5
34	22MAO02	Numerical Computing	3	1	0	4	Maths	5
35	22MAO03	Stochastic Processes and Queuing Theory	3	1	0	4	Maths	5
36	22MAO04	Statistics for Engineers and Data Scientists	3	1	0	4	Maths	5
37	22PHO01	Thin Film Technology	3	1	0	4	Physics	5
38	22PHO02	High Energy Storage Devices	3	1	0	4	Physics	5
39	22PHO03	Structural and optical Characterization of Materials	3	1	0	4	Physics	5
40	22CYO01	Instrumental Methods of Analysis	3	1	0	4	Chemistry	5
41	22CYO02	Chemistry Concepts for Competitive Examinations	3	1	0	4	Chemistry	5
42	22CYO03	Organic Chemistry for Industry	3	1	0	4	Chemistry	5
43	22CEO01	Disaster Management	3	1	0	4	Civil	6
44	22MEX02	Design of Experiments	3	0	2	4	Mech	6
45	22MTO02	Robotics	3	1	0	4	MTS	6
46	22MTO03	3D Printing and Design	3	1	0	4	MTS	6
47	22AUO02	Vehicle Maintenance	3	1	0	4	Auto	6
48	22ECX03	PCB Design And Fabrication	3	0	2	4	ECE	6

49	22EIO03	PLC Programming and its Applications	3	1	0	4	EIE	6
50	22EIO04	Virtual Instrumentation	3	1	0	4	EIE	6
51	22EEO07	Energy Conservation and Management	3	1	0	4	EEE	6
52	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	EEE	6
53	22EEO09	Programmable Logic Controller and SCADA	3	1	0	4	EEE	6
54	22EEO10	VLSI System Design	3	1	0	4	EEE	6
55	22EEO11	Industrial Automation	3	1	0	4	EEE	6
56	22CSX04	Foundations of Machine Learning	3	0	2	4	CSE	6
57	22CSX05	Web Engineering	3	0	2	4	CSE	6
58	22ITX02	Advanced Java Programming	3	0	2	4	IT	6
59	22ITO02	Internet of Things	3	1	0	4	IT	6
60	22ITO03	Fundamentals of Software Development	3	1	0	4	IT	6
61	22ITO04	Mobile Application Development	3	1	0	4	IT	6
62	22CHO04	Air Pollution Monitoring and Control	3	1	0	4	Chem	6
63	22CHO05	Paints and Coatings	3	1	0	4	Chem	6
64	22CHO06	Powder Technology	3	1	0	4	Chem	6
65	22FTX02	Processing of milk and milk products	3	0	2	4	FT	6
66	22FTX03	Processing of Fruits and Vegetables	3	0	2	4	FT	6
67	22CDX01	Fundamentals of User Interactive Design	3	0	2	4	CSD	6
68	22ADX01	Data Visualization	3	0	2	4	AI	6
69	22ALX01	Data Exploration and Visualization Techniques	3	0	2	4	AI	6
70	22MAO05	Graph Theory and its Applications	3	1	0	4	Maths	6
71	22MAX01	Data Analytics Using R Programming	3	0	2	4	Maths	6
72	22MAO06	Operations Research	3	1	0	4	Maths	6
73	22MAO07	Number Theory and Cryptography	3	1	0	4	Maths	6

74	22PHO04	Synthesis, Characterization And Biological Applications Of Nanomaterials	3	1	0	4	Physics	6
75	22PHO05	Techniques of Crystal Growth	3	1	0	4	Physics	6
76	22CYO04	Corrosion Science and Engineering	3	1	0	4	Chemistry	6
77	22CYO05	Chemistry of Cosmetics in Daily Life	3	1	0	4	Chemistry	6
78	22CYO06	Nano composite Materials	3	1	0	4	Chemistry	6
79	22CEO02	Introduction to Smart Cities	3	0	0	3	Civil	7
80	22CEO03	Environmental Health and Safety	3	0	0	3	Civil	7
81	22MEO01	Fundamentals of Ergonomics	3	0	0	3	Mech	7
82	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	Mech	7
83	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	Mech	7
84	22MTO04	Drone System Technology	3	0	0	3	MTS	7
85	22AUO03	Public Transport Management	3	0	0	3	Auto	7
86	22ECO01	Wearable Devices	3	0	0	3	ECE	7
87	22ECX04	Electronic Hardware And Troubleshooting	2	0	2	3	ECE	7
88	22EEO12	Electric Vehicle	3	0	0	3	EEE	7
89	22EEO13	E-Waste Management	3	0	0	3	EEE	7
90	22EEO14	Embedded System Design	3	0	0	3	EEE	7
91	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	EEE	7
92	22EEO16	Digital Image Processing	3	0	0	3	EEE	7
93	22EEO17	AI techniques for Engineering Applications	3	0	0	3	EEE	7
94	22EIO05	Industry 4.0 with Industrial IoT	3	0	0	3	EIE	7
95	22EIO06	Industrial Data Communication	3	0	0	3	EIE	7
96	22EIO07	Wireless Instrumentation	3	0	0	3	EIE	7
97	22EIO08	Instrumentation Techniques in Agriculture	3	0	0	3	EIE	7
98	22CSO03	Nature Inspired optimization techniques	3	0	0	3	CSE	7
99	22ITO05	Fundamentals of Cloud Computing	3	0	0	3	IT	7

100	22ITO06	Introduction to Ethical Hacking	3	0	0	3	IT	7
101	22CHO07	Hydrogen Energy	3	0	0	3	Chem	7
102	22CHO08	Rubber Technology	3	0	0	3	Chem	7
103	22FTO02	Principles of Food safety	3	0	0	3	FT	7
104	22FTO03	Fundamentals of Food Packaging and Storage	3	0	0	3	FT	7
105	22CDO02	Introduction to Mobile Game Design	3	0	0	3	CSD	7
106	22ADO02	Neural Networks and Deep Learning	3	0	0	3	AI	7
107	22ALO02	Industrial Machine Learning	3	0	0	3	AI	7
108	22MAO08	Non-Linear Optimization	3	0	0	3	Maths	7
109	22MAO09	Optimization for Engineers	3	0	0	3	Maths	7
110	22CYO07	Waste and Hazardous Waste Management	3	0	0	3	Chemistry	7
111	22CYO08	Chemistry in Everyday Life	3	0	0	3	Chemistry	7
112	22CEO04	Infrastructure Planning and Management	3	0	0	3	Civil	8
113	22CEO05	Environmental Laws and Policy	3	0	0	3	Civil	8
114	22MEO04	Safety Measures for Engineers	3	0	0	3	Mech	8
115	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	Mech	8
116	22MEO06	Climate Change and New Energy Technology	3	0	0	3	Mech	8
117	22MTO05	Micro and Nano Electromechanical Systems	3	0	0	3	MTS	8
118	22MTO06	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS	8
119	22AUO04	Autonomous Vehicles	3	0	0	3	Auto	8
120	22ECO02	Optical Engineering	3	0	0	3	ECE	8
121	22EEO18	Smart Grid technologies	3	0	0	3	EEE	8
122	22EEO19	Biomass Energy System	3	0	0	3	EEE	8
123	22EIO09	Environmental Sensor	3	0	0	3	EIE	8
124	22EIO10	Pollution Control and Management	3	0	0	3	EIE	8

125	22CSO04	Machine Translation	3	0	0	3	CSE	8
126	22CSO05	Fundamentals of Block chain	3	0	0	3	CSE	8
127	22ITO07	Business Continuity Planning	3	0	0	3	IT	8
128	22CHO09	Industrial Accident Prevention and Management	3	0	0	3	Chem	8
129	22CHO10	Electrochemical Engineering	3	0	0	3	Chem	8
130	22CHO11	Smart and Functional Materials	3	0	0	3	Chem	8
131	22FTO04	Food Ingredients	3	0	0	3	FT	8
132	22FTO05	Food and Nutrition	3	0	0	3	FT	8
133	22CDO03	Introduction to Graphics Design	3	0	0	3	CSD	8
134	22CDX02	Virtual Reality and Augmented Reality	2	0	2	3	CSD	8
135	22ADO03	Business Analytics	3	0	0	3	AI	8
136	22ALO03	Machine Learning for Smart Cities	3	0	0	3	AI	8
137	22CYO09	Chemistry of Nutrition for Women Health	3	0	0	3	Chemistry	8

LIST OF OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS

(Common to all BE/ BTech branches including ECE branch)

1	22GEO01	German Language Level 1	4	0	0	4	ECE	V/VI/VII/VIII
2	22GEO02	Japanese Language Level 1	4	0	0	4	ECE	V/VI/VII/VIII
3	22GEO03	Design Thinking for Engineers	3	1	0	4	CSE	V
4	22GEO04	Innovation and Business Model Development	3	1	0	4	MTS	VI
5	22GEO05	German Language Level 2	4	0	0	4	ECE	V/VI/VII/VIII
6	22GEO06	German Language Level 3	3	0	0	3	ECE	V/VI/VII/VIII
7	22GEO07	German Language Level 4	3	0	0	3	ECE	V/VI/VII/VIII
8	22GEO08	Japanese Language Level 2	4	0	0	4	ECE	V/VI/VII/VIII
9	22GEO09	Japanese Language Level 3	3	0	0	3	ECE	V/VI/VII/VIII
10	22GEO10	Japanese Language Level 4	3	0	0	3	ECE	V/VI/VII/VIII
11	22GEO11	French Language Level 1	4	0	0	4	ECE	V/VI/VII/VIII
12	22GEO12	French Language Level 2	4	0	0	4	ECE	V/VI/VII/VIII
13	22GEO13	French Language Level 3	3	0	0	3	ECE	V/VI/VII/VIII
14	22GEO14	Spanish Language Level 1	4	0	0	4	ECE	V/VI/VII/VIII

15	22GEO15	Spanish Language Level 2	4	0	0	4	ECE	V/VI/VII/VIII
16	22GEO16	Spanish Language Level 3	3	0	0	3	ECE	V/VI/VII/VIII
17	22GEO17	Entrepreneurship Development	3	0	0	3	MTS	VIII
18	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	EEE	V/VI
19	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT	V/VI
20	22MBO01	Cost Accounting for Engineers	4	0	0	4	MBA	V
21	22MBO02	Economic Analysis for Decision Making	4	0	0	4	MBA	VI
22	22MBO03	Marketing Analytics	4	0	0	4	MBA	VII

22EGT11 - COMMUNICATION SKILLS I							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**I**	**HS**	**3**	**0**	**0**	**3**

Preamble	This course is designed to impart required levels of Communication Skills and Proficiency in English language necessary for different professional contexts.	
Unit – I	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Parts of speech - Tenses - Types of sentences**:** Assertive, Imperative, Interrogative & Exclamatory **–** Affirmative & Negative - Gerunds & Infinitives - **Vocabulary:** Affixes - Synonyms & Antonyms - **Listening:** Types of listening - Barriers to listening - Listening to short talks - TV shows - **Speaking:** Verbal & Non-verbal communication - Pair conversation - Role play - **Reading:** Types of Reading **–** Intensive: scanning, word by word, survey - **Writing:** Dialogue writing, Informal Letters - Paragraph writing		
Unit – II	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Voices - Impersonal passives - **Vocabulary:** Homonyms, Homophones & Homographs - **Listening:** Importance of listening - Listening to announcements & radio broadcasts - **Speaking:** Persuasive & Impromptu talks - Narrating a story - **Reading:** Reading comprehension - Articles from Newspapers/Magazines - Cloze exercises - **Writing:** Essay writing, Jumbled sentences		
Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Prepositions - **Vocabulary:** Compound Nouns - **Listening:** Listening to TED Talks, Commentaries - **Speaking:** Self Introduction - **Reading:** Extensive: speed, skimming - Identifying lexical & contextual meanings - **Writing:** Instructions & Warnings - Formal letters: Seeking permission for Industrial visits & Inviting guests		
Unit – IV	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Articles & Determiners - **Vocabulary:** Technical Vocabulary - Analogy - Unscrambling words - Logical reasoning - **Listening:** Listening to conversations - **Speaking:** Tongue twisters - Skill Sharing - Note-taking - **Reading:** Note making - Paraphrasing & Summarizing - **Writing:** Recommendations & Suggestions - Business letters: Enquiry, Calling for quotations & placing orders		
Unit – V	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Cause and effect expressions - **Vocabulary:** Abbreviations & acronyms, Definitions **Listening:** Listening to eminent personalities - **Speaking:** Commonly mispronounced words - Welcome address, Chief guest address & Vote of thanks - **Reading** - IELTS type passages - **Writing:** Preparing transcript for a speech - Interpreting news articles & advertisements		
		Total:45

TEXT BOOK:

1.	Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
2.	S. P. Dhanavel, "English and Communication Skills for Students of Science and Engineering", Orient BlackSwan Publishers, Hyderabad, 2009.
3.	Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 1, 3rd Edition, Cambridge University Press, New York, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	use language effectively by acquiring vocabulary and syntax in context	Applying (K3)
CO2	listen and comprehend different spoken discourses from a variety of situations	Applying (K3)
CO3	speak confidently in different professional contexts and with peers	Creating (K6)
CO4	comprehend different genres of texts by adopting various reading strategies	Understanding (K2)
CO5	write legibly and flawlessly at varied professional contexts proficiently with appropriate choice of words and structures	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			1	3	1	1
CO2									2	3		1
CO3									2	3		2
CO4						1				3	1	1
CO5										3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		37	30			33	100
CAT2		30	30			40	100
CAT3		33	34			33	
ESE		17	63			20	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MAC11 - MATRICES AND ORDINARY DIFFERENTIAL EQUATIONS							
(Common to all Engineering and Technology branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**1***	**2***	**4**
Preamble	To provide the skills to the students for solving different real time problems by applying matrices and ordinary differential equations.						
Unit – I	**Matrices:**						**9+3**
Introduction **–** Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation – Applications of Eigen values and Eigen vectors: Stretching of an elastic membrane.							
Unit – II	**Ordinary Differential Equations:**						**9**
Introduction – Solutions of First order differential equations: Exact differential equations – Leibnitz's Linear Equation – Bernoulli's equation –Clairaut's equation - Applications: Law of natural growth and decay.							
Unit – III	**Ordinary Differential Equations of Higher Order:**						**9**
Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax / sinax – x^n – $e^{ax}x^n$, e^{ax} sinbx and e^{ax} cosbx – x^n sinax and x^n cosax – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation.							
Unit – IV	**Applications of Ordinary Differential Equations:**						**9**
Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Applications of differential equations: Simple harmonic motion – Electric circuits (Differential equations and associated conditions need to be given).							
Unit – V	**Laplace Transform:**						**9**
Laplace Transform: Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms –Transforms of derivatives and integrals – Transform of unit step function – Transform of periodic functions. Inverse Laplace transform: Inverse Laplace transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – Applications: Solution of linear ODE of second order with constant coefficients.							
LIST OF EXPERIMENTS / EXERCISES:							
1.	Introduction to MATLAB						
2.	Computation of eigen values and eigen vectors						
3.	Plotting and visualizing single variable functions						
4.	Solving first and second order ordinary differential equations						
5.	Solution of Simultaneous first order ODEs						
6.	Solving second order ODE by variation of parameters						
7.	Determining Laplace and inverse Laplace transform of basic functions						
8.	Solution of Second order ODE by employing Laplace transforms						
							Lecture:45, Tutorials and Practical:15, Total:60
TEXT BOOK:							
1.	Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.						

REFERENCES/ MANUAL / SOFTWARE:	
1.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
2.	Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2014, S.Chand and Co., New Delhi.
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	Grewal B.S., "Higher Engineering Mathematics" 44thEdition, Khanna Publishers, New Delhi, 2018.
5.	Matrices and Ordinary Differential Equations Laboratory Manual.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	solve engineering problems which needs matrix computations.	Applying (K3), Manipulation (S2)
CO2	identify the appropriate method for solving first order ordinary differential equations.	Applying (K3), Manipulation (S2)
CO3	solve higher order linear differential equations with constant and variable coefficients.	Applying (K3), Manipulation (S2)
CO4	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.	Applying (K3), Manipulation (S2)
CO5	apply Laplace Transform to find solutions of Linear Ordinary Differential Equations	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		3									
CO2	3	3	2		3									
CO3	3	3	2		3									
CO4	3	3	2		3									
CO5	3	3	3		3									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

*Alternate week

22CYT11 – CHEMISTRY FOR ELECTRONICS AND COMMUNICATION ENGINEERING							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to equip the engineering students to realize the importance of chemistry in electrochemical storage devices, organic electronic materials, insulating materials, fuels & combustion and the need for e-waste management.

Unit – I ELECTROCHEMICAL STORAGE DEVICES 9

Batteries: Introduction**-** types of batteries - discharging and charging of battery - characteristics of battery - battery rating - various tests on battery -– primary battery: silver button cell - secondary battery: Ni-Cd battery - modern battery: lithium-ion battery - maintenance of batteries - choice of batteries for electric vehicle applications.
Fuel Cells: Introduction-Importance and classification of fuel cells - description, principle, components and applications of fuel cells: H_2-O_2 fuel cell, alkaline fuel cell, molten carbonate fuel cell and direct methanol fuel cell.

Unit – II ORGANIC ELECTRONIC MATERIALS 9

Introduction – conducting polymers – p-type and n-type organic semiconducting materials – advantages over inorganic semiconducting materials – organic dielectric materials – processing and fabrication - spin coating, evaporation, sputtering, electrospinning, drop casting, templating - organic light emitting diodes – working, types and applications – comparison of LCD vs LED –organic field-effect transistors and organic solar cells- working, types and applications.

Unit – III INSULATING MATERIALS 9

Introduction - requirements - classification (solid, liquid & gas) - preparation, properties and applications of : solid inorganic insulators: glass, ceramic products - solid organic insulator: epoxy resin - liquid insulator: transformer oil - gas insulator: SF_6 - electrical resistivity - factors influencing electrical resistivity of materials - composition, properties and applications of high resistivity materials: constantan, molybdenum disilicide and nichrome - polymers as electrical insulators - non-polar polymers - polar polymers - polarization of polymers.

Unit – IV FUELS AND COMBUSTION 9

Introduction – classification of fuels - characteristics of a good fuel - combustion - calorific values – gross and net calorific values - theoretical calculation of calorific value by Dulong's formula - flue gas analysis by Orsat's method - solid fuels - coal and its varieties –proximate analysis – significance – metallurgical coke - Otto-Hoffman byproduct method - liquid fuel - refining of petroleum – manufacture of synthetic petrol - hydrogenation of coal - bergius process - knocking: spark ignition engine - octane number, compression ignition engine - cetane number - power alcohol and biodiesel - gaseous fuel - water gas - introduction of Bharat Stage Emission Standard (BSES) system.

Unit – V E-WASTE AND ITS MANAGEMENT 9

Introduction-E- Waste – definition - sources of e-waste– hazardous substances in e-waste - effects of e-waste on environment and human health- need for e-waste management– e-waste handling rules - waste minimization techniques for managing e-waste – recycling of e-waste - disposal treatment methods of e- waste- mechanism of extraction of precious metal from leaching solution – global scenario of E-waste – E-waste in India- case studies.

Total:45

TEXT BOOK:

1. Wiley Editorial Board, "Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019,for Unit-I, III, IV.
2. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K. & Kowshalya V.N., "Environmental Science", Revised Edition, Pearson Education, New Delhi, 2019, for Unit-I, II, V.

REFERENCES:

1. Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., "Applied Chemistry", 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
2. Payal B. Joshi, Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
3. Palanna O., "Engineering Chemistry", McGraw Hill Education, New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use the concepts of batteries, fuel cells and their applications in various fields.	Applying (K3)
CO2	utilize the organic electronic materials for various applications	Applying (K3)
CO3	apply the knowledge of insulators to make different insulating materials for various applications	Applying (K3)
CO4	apply the concepts of fuels and combustion for engineering applications	Applying (K3)
CO5	utilize the knowledge to handle the e-waste and reduce its impacts on environment	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	1	1	1										
CO4	3	1	1	1										
CO5	3	2	1	1			3							

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT11 - CIRCUITS AND NETWORKS							
Programme& Branch	**B.E & ELECTRONICS AND COMMUNICATION ENGINEERING**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course provides an insight on basic laws and theorems to solve different DC, AC circuits and networks and to expose them to the rudiments of the course which is essential for subsequent courses.	
Unit – I	**DC Circuits:**	**9**
Review of Current Electricity and basic Kirchoff's Laws- Star-Delta Transformation -Mesh Analysis-Nodal Analysis -Superposition Theorem-Thevenin Theorem, Norton Theorem-Maximum Power Transfer Theorem		
Unit – II	**AC Circuits:**	**9**
Review of AC concepts-Mesh Analysis-Nodal Analysis – Star-Delta Transformation-Superposition Theorem-Thevenin Theorem, Norton Theorem-Maximum Power Transfer Theorem		
Unit – III	**Transient Analysis:**	**9**
Complex Impedance and Phasor Diagram-Review-Basic Laplace Transforms-DC response of RL,RC and RLC Circuits – Sinusoidal response of RL, RC and RLC circuits		
Unit – IV	**Resonance:**	**9**
Series Resonance-Impedance and Phase Angle of a Series Resonant Circuit-Voltages and Currents in a Series Resonant Circuit-Bandwidth of an RLC circuit-Quality Factor(Q) and its Effect on Bandwidth-Parallel Resonance-Resonant Frequency for a Tank Circuit- Q-Factor of Parallel Resonance.		
Unit – V	**Two Port Network:**	**9**
Two-port Network-Open-Circuit Impedance (Z) Parameters-Short-Circuit Admittance (Y) Parameters-Transmission (ABCD) Parameters-Hybrid (H) Parameters-Lattice Network.		
		Total:45

TEXT BOOK:	
1.	Sudhakar A. and Shyammohan S. Palli, “Circuits and Networks Analysis and Synthesis”, 5th Edition, McGraw-Hill Education, New Delhi, 2017.
REFERENCES:	
1.	Hayt W.H., Kemmerly J.E., Durbin S.M., “Engineering Circuit Analysis”, 9th Edition, Tata McGraw-Hill, New Delhi, 2020.
2.	Ravish R. Singh, “Network Analysis and Synthesis”,McGraw-Hill Education, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	make use of various theorems and obtain reduced DC Circuits.	Applying (K3)
CO2	apply various network theorems and reduce the complicated AC circuits.	Applying (K3)
CO3	analyze circuit transients for RL, RC and RLC circuits.	Applying (K3)
CO4	apply condition for resonance in series and parallel circuits to find the various parameters.	Applying (K3)
CO5	determine the various parameters of a two port network.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1								2	3	2
CO2	3	2	1	1								2	3	2
CO3	3	3	2	1								2	3	2
CO4	3	2	1	1								2	3	2
CO5	3	2	1	1								2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	13	12	75	-	-	-	100
CAT2	13	25	62	-	-	-	100
CAT3	5	15	80	-	-	-	100
ESE	5	10	85	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22CSC11 - PROBLEM SOLVING AND PROGRAMMING IN C							
(Common to All Engineering and Technology branches except CSE, IT, CSD, AIDS & AIML)							
Programme & Branch	**All BE/BTech Engineering & Technology branches , except CSE, IT, CSD, AIDS & AIML**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**0**	**2**	**4**
Preamble	The course aims to provide exposure to problem-solving through programming. It introduces all the fundamental concepts of C Programming. This course provides adequate knowledge to solve problems using C						
Unit – I	**Introduction to C and Operators:**						**9**
The structure of a C program – Compiling and executing C program – C Tokens – Character set in C – Keywords – identifiers- Basic data Types – Variables – constants – Input / Output statements – Operators							
Unit – II	**Control Statements and Arrays:**						**9**
Decision-making and looping statements, Arrays: Declaring, initializing and accessing arrays – operations on arrays – Two-dimensional arrays and their operations.							
Unit – III	**Functions:**						**9**
Functions: Introduction- Using functions, function declaration and definition – function call – return statement – passing parameters to functions: basic data types and arrays – storage classes – recursive functions							
Unit – IV	**Strings and Pointers:**						**9**
Strings: Introduction – operations on strings: finding length, concatenation, comparing and copying – string and character manipulation functions, Arrays of strings. Pointers : declaring pointer variables – pointer expression and arithmetic, pointers and 1D arrays, pointers and strings							
Unit – V	**User-defined Data Types and File Handling:**						**9**
User-defined data types: Structure: Introduction – nested structures– arrays of structure – structure and functions -unions – enumerated data type. File Handling : Introduction - opening and closing files – reading and writing data to files -Manipulating file position indicator : fseek(), ftell() and rewind()							

LIST OF EXPERIMENTS / EXERCISES:	
1.	Programs for demonstrating the use of different types of format Specifiers
2.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational, and ternary operators
3.	Programs for demonstrating the use of using decision making statements
4.	Programs for demonstrating the use of repetitive structures
5.	Programs for demonstrating one-dimensional arrays
6.	Programs for demonstrating two-dimensional arrays
7.	Programs to demonstrate modular programming concepts using functions
8.	Programs to demonstrate recursive functions.
9.	Programs to demonstrate strings (Using built-in and user-definedfunctions)
10.	Programs to illustrate the use of pointers
11.	Programs to illustrate the use of structures and unions
12.	Programs to implement file Handling
	Lecture:45, Practical:30, Total:75
TEXT BOOK:	
1.	Reema Thareja, “Programming in C ”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:	
1.	Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
2.	Sumitabha Das, “Computer Fundamentals and C Programming”, 1st Edition, McGraw Hill, 2018.
3.	Balagurusamy E., "Programming in ANSI C", 7th Edition, McGraw Hill Education, 2017.
4.	Behrouz A. Forouzan & Richard F.Gilberg, “Computer Science A Structured Programming Approach Using C”, 3rd Edition, Cengage,2017.
5.	https://www.cprogramming.com/tutorial/c-tutorial.html

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	develop simple programs using input/output statements and operators	Applying (K3), Precision (S3)
CO2	identify the appropriate looping and control statements in C and develop applications using these statements	Applying (K3), Precision (S3)
CO3	develop simple C programs using the concepts of arrays and modular programming	Applying (K3), Precision (S3)
CO4	apply the concepts of pointers and develop C programs using strings and pointers	Applying (K3), Precision (S3)
CO5	make use of user-defined data types and file concepts to solve given problems	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1				1	1		1		
CO2	3	2	2	2	1				1	1		1		
CO3	3	2	2	2	1				1	1		1		
CO4	3	2	2	2	1				1	1		1		
CO5	3	2	2	2	1				1	1		1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	30	60				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT12 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING							
Programme & Branch	**B.E & ELECTRONICS AND COMMUNICATION ENGINEERING**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**ES**	**3**	**0**	**0**	**3**

Preamble	To understand about the construction and working principle of various electrical machines, semiconductor devices like diode, FET, BJT, Thyristors and power supply circuits.	
Unit – I	**Electrical Machines:**	**9**
DC Motors and Generators: Construction and working principle – Types – EMF equation – Torque developed in motors - applications. **AC Machines**: Construction and working principle of Synchronous motors - single phase and three phase induction machines –Alternators - applications.		
Unit – II	**Transformers:**	**9**
Basic operation - construction and working principle of single phase and three phase transformers - EMF equation - testing of transformers - no load and load test – losses and efficiency calculations – phasor diagrams - applications.		
Unit – III	**Semiconductor Theory and Devices:**	**9**
Review of intrinsic and extrinsic semiconductors – Conductivity and mobility – Carrier concentration in intrinsic semiconductor – Mass Action Law - Fermi level – Charge densities in semiconductor -Drift and diffusion current. **Devices:** Construction of PN junction diodes – VI characteristics – Transition and diffusion capacitances – Zener diode – Characteristics of Zener diode- LDR. Practical component: Simulation of characteristics of PN junction diode.		
Unit – IV	**BJT, FET, MOSFET and UJT:**	**9**
BJT-Construction and Principle of Operation – I/O characteristics of BJT in CE, CB and CC configurations. **FET:** JFET: Construction – Characteristics – MOSFET: Construction – Depletion and enhancement mode – Characteristics of MOSFET – UJT: Construction and principle of operation-characteristics. Practical component: Simulation of characteristics of BJT.		
Unit – V	**Thyristors and Power Supply Circuits:**	**9**
SCR-TRIAC-Half wave and Full wave Bridge rectifiers with resistive load using diodes – Analysis for Vdc and ripple voltage with C, L, LC and CLC filters. Zener diode regulator –Transistor voltage regulators: Series and shunt – Line regulation and load regulation.		
		Total:45

TEXT BOOK:

1.	BL Theraja, AK Theraja, “A textbook of Electrical Technology, Volume II”, 23rd edition, S.Chand Publishing, Reprint 2020, for Units I & II.
2.	Salivahanan S. and Sureshkumar N., “Electronic Devices and Circuits”, 4th Edition, McGraw-Hill, New Delhi, 2017, for Units III, IV & V.

REFERENCES/ MANUAL / SOFTWARE:

1.	DP Kothari, IJ Nagrath, “Electric Machines”, 4th Edition, Tata Mc Graw Hill, 2020.
2.	Adel S.Sedra, Kenneth C. Smith and Arun N.Chandorkar, “Microelectronic Circuits” 7th Edition, Oxford University Press, New York, 2017.
3.	Bell, David A ,”Solid State Pulse Circuits”, 5th Edition, Oxford University Press, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the construction and working principles of various electrical machines	Understanding (K2)
CO2	Understand the working of transformers and its testing procedures.	Understanding (K2)
CO3	comprehend the construction, characteristics and applications of various electronic devices	Understanding (K2)
CO4	demonstrate the configurations of BJT, FET and its applications.	Understanding (K2)
CO5	design various power supply circuits.	Applying (K3)

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1		2	1	1	2	2		2	1	1
CO2	2	1	1	1		2	1	1	2	2		2	1	1
CO3	2	2	1	2	3	2	2		2	2		2	3	2
CO4	3	2	2	3	3	2	2		2	2		2	2	3
CO5	3	3	2	3		3	3	3	2	2		3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
CAT3	20	40	40	-	-	-	100
ESE	20	60	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECL11 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

Programme & Branch	B.E & ELECTRONICS AND COMMUNICATION ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**1**	**BS**	**0**	**0**	**3**	**1**

Preamble	This course is designed to provide a hands-on experience in basics of electrical and electronics engineering.

LIST OF EXPERIMENTS / EXERCISES:

1.	Load test on DC shunt motor.
2.	Load test on single phase induction motor.
3.	Load test on single phase transformer
4.	Open circuit and short circuit test on transformer.
5.	Light ON/OFF control using Light Dependent Resistor (LDR).
6.	Application of BJT as ON/OFF switch.
7.	Controlling of DC FAN using MOSFET.
8.	Controlling of DC motor using SCR.
9.	Design of power supply unit for electronic gadgets.
10.	Simulation of following experiments using Pspice. i) Characteristics of BJT(common emitter configuration) ii) Characteristics of UJT

Total:45

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Orcad Cadence PSpice Software 16.6

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	test basic electrical machines like transformer and DC motors	Applying (K3), Manipulation(S2)
CO2	demonstrate the applications of various electronic devices	Applying (K3), Manipulation(S2)
CO3	perform simulation of the characteristics of devices using electronic systems design tools	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2		2	2	2	3	2		2	2	2
CO2	3	3	2	2		2	2	2	2	2		3	2	2
CO3	2	2	2	2	3	2	2	2	2	2		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22CYL11 - CHEMISTRY LABORATORY FOR ELECTRICAL SYSTEMS							
(Common to ECE, EEE and EIE Branches)							
Programme & Branch	**B.E - ECE, EEE & EIE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**BS**	**0**	**0**	**3**	**1**

Preamble	This course aims to impart the basic concepts of volumetric, conductometric, potentiometric, viscometry, spectrophotometric and pH metry experiments for the estimation of given samples and thereby, to improve the analytical skills. This course also aims to impart the significance of DO, alkalinity, Cu^{2+} and Cr^{6+} in electrical systems.

LIST OF EXPERIMENTS / EXERCISES:	
1.	Iodometric analysis of copper content from discarded PCBs.
2.	Volumetric analysis of chromium prepared from electroplating sludge.
3.	Find the amount of mineral acids present in the given solution by conductometric based sensor electrode.
4.	Determination of concentration of H^+ ion in a solution using H^+ sensing electrode.
5.	Potentiometric approach using a Pt electrode for the estimation of iron in the given sample.
6.	Determination of molecular weight of a polymer / liquid by Ostwald viscometer.
7.	Spectrophotometric method for the determination of Iron in steel.
8.	Assessment of the given water sample for the suitability of drinking / industrial purpose by estimating the calcium, magnesium and total hardness by EDTA method.
9.	Estimation of alkalinity of river and borewell water collected from different places.
10.	Determination of dissolved oxygen in the given wastewater sample.
11.	Electroplating process (Demonstration).
12.	Proximate analysis of Coal- determine moisture, volatile matter and ash content of a given sample of coal (Demonstration).
	Total:30

REFERENCES/ MANUAL /SOFTWARE:	
1.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., “Chemistry Laboratory Manual”, 1st Edition, Rajaganapathy Publishers, Erode, 2022.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	estimate the amount of hardness, alkalinity, DO, Cu and Cr present in the given sample.	Applying (K3), Precision (S3)
CO2	analyze the amount of acids present in the given sample using conductivity and pH meter.	Applying (K3), Precision (S3)
CO3	demonstrate the potentiometric and spectrophotometric method for the estimation of Fe and Viscometer for the determination of molecular weight of a polymer.	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3			3							
CO2	3	2	1	3			3							
CO3	3	2	1	3			2							

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

22EGT21 - COMMUNICATION SKILLS II								
(Common to All Engineering and Technology Branches)								
Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Communication Skills I**	**2**	**HS**	**3**	**0**	**0**	**3**	

Preamble	This course is designed to equip students with the necessary skills to listen, read, write and speak so as to develop their linguistic and communicative competencies.	
Unit – I	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Sentence Patterns **-** Simple, Compound & Complex sentences **- Vocabulary:** Portmanteau words **-** One word substitution **- Listening:** Speeches from company CEOs **-** TV debates **Speaking:** Just-a-minute talk **-** Group discussion **- Reading:** Reading for Gist **- Writing:** Job application letter with resume **–** Transcoding		
Unit – II	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Concord **- Vocabulary:** Phrasal verbs **-** Idioms & Phrases - **Listening:** Listening to celebrity talks - **Speaking:** Talking about celebrities - Practicing Pronunciation through web tools - **Reading:** Company correspondence, technical texts/working principles of a machine - **Writing:** Description: Person, Place**,** Process, Product and Picture		
Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Discourse markers **-** Transitional words and phrases **- Vocabulary:** Commonly confused words **- Listening:** Listening to guest lectures **- Speaking:** Technical & Non-technical presentations **-** Workshop presentations **- Reading:** Reputed company profiles, Business Plans **- Writing:** a dream job/company **-** Letter to the Editor **–** Biography & Autobiography **-** Checklist		
Unit – IV	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Degrees of Comparison **-** Punctuations **–** Fragments & run-ons **- Vocabulary:** British & American **-** Spelling & words **- Listening:** Listening to global accents **-** listening to motivational speeches **-** S**peaking:** Narrating personal milestones **-** Sports commentaries **-** Movie Enactment **- Reading:** Narrative passages **- Writing:** E mail **-** Agenda & Minutes of Meeting **-** Special & Technical reports		
Unit – V	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Purpose and Function **-** If clause **-** Error detection **- Vocabulary:** Coding & Decoding **-** Alphabet test **- Listening:** Listening to sample HR Interviews **- Speaking:** Introduction to phonetics - Stress, rhythm & Intonation **–** Guided & unguided speeches/conversations **-** Giving feedback **–** Debate **- Reading:** Key Note speeches **-** Newspaper reports **-** short technical texts from journals **Writing:** Circulars **-** Critical Appreciation of a non-detailed text **-** Technical proposals		
		Total:45

TEXT BOOK:

1.	Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.
2.	Murphy Raymond, "English Grammar in Use", 5th Edition, Cambridge University Press, New York, 2019.
3.	Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 2, 3rd Edition, Cambridge University Press, New York, 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use functional grammar for improving communication skills	Applying (K3)
CO2	listen and comprehend different accents and infer implied meanings	Applying (K3)
CO3	speak clearly, initiate and sustain a discussion and negotiate using appropriate communicative strategies	Creating (K6)
CO4	read different genres of texts, infer implied meanings and critically analyze and evaluate them	Understanding (K2)
CO5	produce different types of narrative, descriptive expository texts and understand creative, critical, analytical and evaluative writing	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			1	3	1	1
CO2									2	3		1
CO3									2	3		2
CO4						1				3	1	1
CO5										3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		37	30			33	100
CAT2		7	50			43	100
CAT3		17	50			33	100
ESE		15	45			40	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MAC21 - MULTIVARIABLE CALCULUS AND COMPLEX ANALYSIS							
(Common to CIVIL, MECH, MTS, ECE, EEE, EIE & FT branches)							
Programme & Branch	**B.E & Civil, Mech, MTS, ECE, EEE, EIE & FT branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**1***	**2***	**4**

Preamble	To impart the knowledge of partial derivatives, evaluation of real and complex integrals, vector calculus and analytic functions to the students for solving the problems related to various engineering disciplines.	
Unit – I	**Functions of Several Variables:**	**9**
Functions of two or more variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Applications: Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method.		
Unit – II	**Multiple Integrals:**	**9**
Double integration in cartesian coordinates – Change of order of integration – Application: Area between two curves – Triple integration in cartesian coordinates – Volume as triple integrals.		
Unit – III	**Vector Calculus:**	**9**
Directional derivative – Gradient of a scalar point function – Divergence of a vector point function – Curl of a vector – Solenoidal and Irrotational vectors – Vector Integration: Introduction – Green's, Stoke's and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.		
Unit – IV	**Analytic Functions:**	**9**
Functions of a complex variable – Analytic functions – Necessary and sufficient conditions (excluding proof) – Cauchy–Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic function – Construction of analytic function – Applications: Fluid flow – Conformal mapping: w = z + a, az, 1/z – Bilinear transformation.		
Unit – V	**Complex Integration:**	**9**
Introduction – Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor's and Laurent series – Singularities – Classification – Cauchy's residue theorem (without proof) – Applications: Evaluation of definite integrals involving sine and cosine functions over the circular contour.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Finding ordinary and partial derivatives
2.	Computing extreme values of function of two variables
3.	Evaluating double and triple integrals
4.	Finding the area between two curves
5.	Computing gradient, divergence and curl of point functions
6.	Applying Milne-Thomson method for constructing analytic function
7.	Determination of Mobius transformation for the given set of points
8.	Finding poles and residues of an analytic function

Lecture:45, Tutorials and Practical:15, Total:60

TEXT BOOK:

1.	Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:

1.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

2.	Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics For First Year B.E/B.Tech”, Reprint Edition 2014, S.Chand and Co., New Delhi
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	Grewal B.S, “Higher Engineering Mathematics" 44thEdition, Khanna Publishers, New Delhi, 2018.
5.	Multivariable Calculus and Complex Analysis Laboratory Manual.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	compute the total derivatives and extreme values of multivariable functions.	Applying (K3), Manipulation (S2)
CO2	evaluate multiple integrals and apply them to compute the area and volume of the regions.	Applying (K3), Manipulation (S2)
CO3	apply the concepts of derivatives and line integrals of vector functions in engineering problems.	Applying (K3), Manipulation (S2)
CO4	construct analytic functions and bilinear transformations and determine the image of given region under the given conformal mapping.	Applying (K3), Manipulation (S2)
CO5	apply the techniques of complex integration to evaluate real and complex integrals over suitable closed curves.	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2		3									
CO2	3	3	2		3									
CO3	3	3			3									
CO4	3	3			2									
CO5	3	3	3		2									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	30	60				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

*Alternate week

22PHT21 – PHYSICS FOR ELECTRONICS AND COMMUNICATION ENGINEERING							
Programme & Branch	**BE- Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to impart the knowledge on oscillations & waves, waveguides, fiber optics, electron and band theory of solids, dielectric materials and smart materials. It also describes the applications of aforementioned topics in electronics and communication engineering.	
Unit – I	**Oscillations and Waves:**	**9**
Periodic motion – Oscillations – Simple harmonic motion – Differential equation of simple harmonic motion – Forced oscillations – Damped oscillations – Application of simple harmonic motion in torsional pendulum, cantilever and LC circuit – Resonance – Waves – Equation of plane progressive wave – Types of progressive waves – Reflection and transmission of waves at a boundary (qualitative) – Energy transport of progressive waves.		
Unit – II	**Waveguides and Fiber optics:**	**9**
Transverse magnetic waves – Transverse electric waves – Transverse electromagnetic waves – Rectangular and circular waveguides (qualitative) – Fiber optics – Numerical aperture and acceptance angle – Classification of optical fibers based on refractive index, modes and materials – Fiber optics communication system (qualitative) – Temperature and displacement sensors.		
Unit – III	**Free electron theory and Band theory of solids:**	**9**
Classical free electron theory of metals – Electrical conductivity – Success and draw backs of classical free electron theory – Quantum free electron theory (qualitative) – Fermi distribution function – Effect of temperature on Fermi Function – Electrons in a periodic potential – Bloch theorem – Brillouin zones (E-K curve) – Origin of energy bands in solids – Classification of solids based on energy bands (conductors, semiconductors and insulators).		
Unit – IV	**Dielectric materials:**	**9**
Dielectrics – Dielectric constant – Polarization – Displacement vector – Electric susceptibility – Types of polarization mechanisms: Electronic, ionic, orientational and space-charge – Frequency and temperature dependence – Internal field – Clausius-Mosotti relation – Dielectric loss – Dielectric breakdown – Uses of dielectric materials in capacitors.		
Unit – V	**Smart Materials:**	**9**
Metallic glasses: Properties, preparation and applications – Shape memory alloys: Characteristics and applications – Nanostructure – Surface-to-volume ratio – Quantum confinement – Nanomaterials synthesis: Top-down and bottom-up approaches – Electron beam lithography – Physical vapour deposition – Carbon nanotubes: Structures, properties, synthesis by laser ablation method – Applications.		
		Total:45

TEXT BOOK:

1.	Hitendra K. Malik and A.K. Singh, "Engineering Physics", 2nd Edition McGraw-Hill Education , New Delhi, 2018.

REFERENCES:

1.	Pandey B.K.and Chaturvedi S., "Engineering Physics" 2nd Edition, Cengage, New Delhi, 2022.
2.	Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
3.	Tamilarasan K. and Prabu K., "Materials Science", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	make use of the concepts of oscillatory and wave motion to comprehend the phenomena related to the propagation of elastic waves.	Applying (K3)
CO2	compute the acceptance angle and numerical aperture of an optical fiber using the concepts of propagation of electromagnetic waves through waveguides and to explain the working of fiber optic communication system and sensors.	Applying (K3)
CO3	apply the concepts of free electron theories and band theory of solids to comprehend the formation of energy bands, energy gap and the classification of solids.	Applying (K3)
CO4	apply the concept of electric dipole moment and electric polarization to comprehend the different polarization mechanisms in dielectrics, Clausius-Mosotti relation, dielectric loss, dielectric breakdown and to describe its uses in capacitors.	Applying (K3)
CO5	utilize appropriate methods to prepare metallic glasses, shape memory alloys, nanomaterials and carbon nano tubes and also to comprehend their properties and applications.	Applying (K3)

Mapping of COs with POs and PSOs

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		2
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		2
CO5	3	2	2						2	2		2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT21 – ELECTROMAGNETIC FIELDS							
Programme & Branch	**B.E & ELECTRONICS AND COMMUNICATION ENGINEERING**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**1**	**0**	**4**

Preamble	To impart the knowledge on the behaviour of electric field and magnetic field in static and time varying environment.	
Unit – I	**Static electric Fields:**	**9+3**
Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co-ordinate-Coulomb's Law in Vector Form – Definition of Electric Field Intensity- Calculation of electric field intensity due to different charge configurations: Point charge, line charge and surface charge-Electric Flux Density – Gauss Law – Proof of Gauss Law – Applications. Electric Scalar Potential – Relationship between potential and electric field - Potential due to infinite uniformly charged line – Potential due to electrical dipole- Simulation of Electric field		
Unit – II	**Conductors and Dielectrics:**	**9+3**
Electric current – Current density – point form of Ohm's law – continuity equation for current--Nature of dielectric materials - Boundary conditions for electric fields- Definition of Capacitance-Several Capacitance examples- Poisson's and Laplace's equation- Capacitance of parallel plate using Laplace's equation.		
Unit – III	**Static Magnetic Field and Magnetic Materials:**	**9+3**
Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I – Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density- Magnetic Vector Potential– Magnetic moment-Nature of magnetic materials -Magnetic boundary conditions-Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance – simple examples		
Unit – IV	**Time Varying Fields and Electromagnetic Waves :**	**9+3**
Faraday's law –Displacement current –Maxwell's four equations in integral form and differential form- Maxwell's equation in Phasor form -Derivation of Wave Equation- Wave equation in Phasor form -Poynting Vector and the flow of power.		
Unit – V	**Uniform Plane Waves:**	**9+3**
Plane waves in lossless dielectric– Plane waves in lossy dielectrics – Propagation in good conductors - Reflection of Plane Wave– normal and oblique incidence-Polarization - Simulation to find parameters of uniform plane wave.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	William H. Hayt, Jr ,John A. Buck, and Jaleel M Akhtar, "Engineering Electromagnetics",9th Edition, McGraw Hill Publishing Company, NewDelhi,2020 (Unit I to V)

REFERENCES:

1.	Edward .C.Jordan. andKeith.G.Balmain "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education , 2015.
2.	Matthew N.O. Sadiku,S.V.Kulkarani, "Principles of Electromagnetics", 6th Edition, Oxford University Press, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	determine the electric field intensity and potential for point and line charge distributions.	Applying (K3)
CO2	apply boundary conditions and derive the capacitance of parallel plate capacitors.	Applying (K3)
CO3	calculate the magnetic field intensity and flux density for current carrying conductor	Applying (K3)
CO4	apply Maxwell's equation and obtain the Wave parameters.	Applying (K3)
CO5	compute the characteristics of uniform plane waves in conductor, lossless and lossy dielectric media	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3				2	2			1	
CO2	3	2	1	1									2	
CO3	3	2	1	1									2	
CO4	3	2	1	1									2	
CO5	3	2	1	1	3				2	2			2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	05	50	45				100
CAT2	05	50	45				100
CAT3	05	50	45				100
ESE	05	55	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22CSC22 – DATA STRUCTURES USING C							
(Common to ECE, EEE, EIE and MTS Branches)							
Programme & Branch	**BE – ECE, EEE, EIE and MTS Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Programming in C**	**2**	**PC**	**3**	**0**	**2**	**4**

Preamble	This course is indented to introduce the concept of elementary data structures and notion of algorithms to novice learner from cross disciplines in Engineering and Technology.	
Unit – I	**List:**	**9**
Data Structures – Abstract Data Types (ADT) – List ADT and Array Implementation – Linked List – Doubly Linked List – Circular Linked List – Application : Polynomial Addition		
Unit – II	**Stack and Queues:**	**9**
Stack ADT – Array and Linked List implementation of Stacks – Application: Balancing Parenthesis- Infix to Postfix Conversion – Postfix Expression Evaluation – Queue ADT – Array and Linked List implementation of Queues – Applications		
Unit – III	**Trees:**	**9**
Trees-Preliminaries – Binary Trees –Binary Tree Traversals – The Search Tree ADT – Binary Search Trees–Priority Queues (Binary Heap)- Application: Expression Tree		
Unit – IV	**Graphs:**	**9**
Graphs – Definitions – Elementary Graph Operations- Traversals – Shortest-Path Algorithms: Unweighted Shortest Paths – Dijkstra‟s Algorithm – Minimum Spanning Tree: Prim‟s Algorithm- Kruskal‟s Algorithm – Applications: Biconnectivity.		
Unit – V	**Sorting and Hashing:**	**9**
Sorting – Preliminaries – Insertion Sort – Quicksort – Merge sort – Heapsort – Hashing – General Idea – Hash Function – Separate Chaining – Open addressing.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Implementation of C programs using pointers
2.	Implementation of singly linked list and its operations
3.	Implementation of doubly linked list and its operations
4.	Implementation of Stack and its operations
5.	Implementation of Queue and its operations
6.	Implementation of Stack and Queue using Singly Linked List
7.	Convert a given In-fix Expression into Post-fix Expression using Stack ADT
8.	Evaluate the Post-fix Expression using Stack ADT
9.	Implementation of Binary Search Tree traversals
10.	Implementation of sorting algorithms: Insertion and Quick sort

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Weiss M. A., “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education Asia, New Delhi, 2016.

REFERENCES/ MANUAL / SOFTWARE:

1.	Horowitz Sahni, Andreson Freed, “Fundamentals of Data Structures in C”, 2nd Edition, Universities Press, Hyderabad, 2011.

2.	Langsam Y.M., Augenstein J. and Tenenbaum A. M., “Data Structures using C and C++”, 2nd Edition, Pearson Education, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply List ADT for solving the given problems	Applying (K3)
CO2	make use of arrays and linked lists to create Stack and Queue ADTs.	Applying (K3)
CO3	utilize Tree ADT to develop simple application	Applying (K3)
CO4	make use of Graph ADT for standard problems	Applying (K3)
CO5	illustrate the use of standard sorting and Hashing Techniques	Applying (K3)

Mapping of Cos with POs and PSOs

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	5	35	60				100
CAT3	5	35	60				100
ESE	5	35	60				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MET11 - ENGINEERING DRAWING							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**ES**	**2**	**1**	**0**	**3**

Preamble	To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.	
Unit – I	**General Principles of Orthographic Projection:**	**6+3**
Importance of Graphics in Engineering Applications - Use of Drafting Instruments - BIS Conventions and Specifications - Size, Layout and Folding of Drawing Sheets - Lettering and Dimensioning - Projections of Points, Lines and Planes - General Principles of Orthographic Projection - First Angle Projection - Layout of Views - Projection of Points Located in all Quadrant and Straight Lines Located in the First Quadrant - Determination of True Lengths and True Inclinations and Location of Traces - Projection of Polygonal Surface and Circular Lamina Inclined to both Reference Planes.		
Unit – II	**Projections of Solid:**	**6+3**
Projections of Simple Solids Like Prisms, Pyramids, Cylinder and Cone when the Axis is inclined to One Reference Plane by Change of Position Method.		
Unit – III	**Sectioning of Solids:**	**6+3**
Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane and Perpendicular to the other - Obtaining True Shape of Section.		
Unit – IV	**Development of Surfaces:**	**6+3**
Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones -Development of Simple Truncated Solids Involving Prisms, Pyramids, Cylinders and Cones.		
Unit – V	**Isometric Projection and Introduction to AutoCAD:**	**6+3**
Principles of Isometric Projection - Isometric Scale - Isometric Projections of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Cones - Conversion of Isometric Projection into Orthographic Projection - Introduction to AutoCAD.		
		Lecture: 30, Tutorial:15, Total:45

TEXT BOOK:

1.	Natarajan.K.V. “A Textbook of Engineering Graphics”,35th Edition, Dhanalakshmi Publishers, Chennai, 2022,

REFERENCES:

1.	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, 16th Edition, New Age International Publishers, Chennai, 2022.
2.	Basant Agrawal, Agrawal C.M., “Engineering Drawing”, 3rd Edition, McGraw Hill Education, 2019.
3.	Parthasarathy N.S., Vela Murali. “Engineering Drawing”, 1st Edition, Oxford University Press, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes	Applying (K3)
CO2	draw the projections of 3D primitive objects like prisms, pyramids, cylinders and cones	Applying (K3)
CO3	construct the various sectional views of solids like prisms, pyramids, cylinders and cones	Applying (K3)
CO4	develop the lateral surfaces of simple and truncated solids	Applying (K3)
CO5	sketch the isometric projections of simple and truncated solids and convert isometric drawing into orthographic projection	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			2					3		2		
CO2	3	2	1		2					3		2		
CO3	3	2	1		2					3		2		
CO4	3	2	1		2					3		2		
CO5	3	2	1		2					3		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	6	9	85				100
CAT2	6	9	85				100
CAT3	6	9	85				100
ESE	10	10	80				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22TAM02 - தமிழரும் தொழில்நுட்பமும்							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

முன்னுரை	தமிழ் கலாச்சாரத்தோடு ஒன்றிய தொழில் நுட்பங்களை பற்றிப் எடுத்துரைத்தல்	
அலகு – I	**நெசவு மற்றும் பானை தொழில்நுட்பம்**	**3**
சங்க காலத்தில் நெசவு தொழில் – பானைத் தொழில்நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் – பாண்டகளில் கீறல் குறியீடுகள்		
அலகு – II	**வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**	**3**
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச்சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் –மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னை இந்தோ-சாரோசெனிக் கட்டிடக் கலை.		
அலகு – III	**உற்பத்தித் தொழில்நுட்பம்**	**3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் – கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு – IV	**வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்**	**3**
அணை, ஏரி, குளங்கள், மதகு – சோழர்கால குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
அலகு – V	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**	**3**
அறிவியல் தமிழின் வளர்ச்சி – கணினிதத்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்.		
		Total:15

TEXT BOOK:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016

REFERENCES:

1.	கீழடி-வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
2.	பொருநை-ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

3.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
4.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamil to Indian Culture (Dr.M.Valarmathi) (Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		BT Mapped (Highest Level)
CO1	தமிழ் கலாச்சாரம் மற்றும் தமிழ் சமூகத்தினுடைய நெசவு மற்றும் பானை தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் உற்பத்தித் தொழில்நுட்பம் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	தமிழர்களின் அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் பற்றி விளக்க முடியும்.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

*** ±3% may be varied (CAT 1,2,3 – 50 marks)**

22TAM02 - TAMILS AND TECHNOLOGY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

Preamble	This course aims to impart the essential knowledge on the tamil culture and related technology	
UNIT – I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads –Terracotta beads –Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.		
UNIT – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total:15

TEXT BOOK:

1.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).

REFERENCES:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016
3.	கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamils to Indian Culture (Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (dr.K.K.Pillay) (Published by : The Author)

9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain weaving and ceramic technology in tamil culture and tamil society.	Understanding (K2)
CO2	Illustrate about the design and construction technology.	Understanding (K2)
CO3	summarize about the manufacturing technology.	Understanding (K2)
CO4	explain the agriculture and irrigation technology.	Understanding (K2)
CO5	explain the significance of tamil in scientific and computing.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

*** ±3% may be varied (CAT 1,2,3 – 50 marks)**

22PHL21 - PHYSICS LABORATORY FOR ELECTRONICS AND COMMUNICATION ENGINEERING							
Programme & Branch	**BE- Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**0**	**0**	**2**	**1**

Preamble	This course aims to impart hands on training in the determination of physical parameters such as rigidity modulus, AC frequency, velocity of ultrasonic waves, compressibility of a liquid, acceptance angle and numerical aperture of an optical fiber, Hall coefficient, wavelength of laser, particle size, specific resistance, thickness of a thin film and knowledge on the working of LCR circuit and p-n junction and also to impart skills on writing coding / developing project / product related to societal requirement.
LIST OF EXPERIMENTS / EXERCISES:	
1.	Determination of the rigidity modulus of the given metallic wire using torsional pendulum.
2.	Studying the variation of current and voltage in a series LCR circuit / Determination of the frequency of alternating current using electrically vibrating tuning fork (Melde's apparatus).
3.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of the liquid using ultrasonic interferometer.
4.	Determination the acceptance angle and numerical aperture of the given optical fiber.
5.	Observation of the I-V characteristics of a p-n diode / Determination of Hall coefficient of a material using Hall effect arrangement.
6.	Determination of the band gap of a given semiconducting material using post-office box.
7.	(i) Determination of the wavelength of the given semiconductor laser. (ii) Determination of the particle size of the given powder using laser.
8.	Determination the specific resistance of the material of a given coil of wire using Carey-Foster's bridge.
9.	Determination of the thickness of a thin film by air-wedge arrangement.
10.	Writing coding for any one of the above experiments / developing a project / a product.
	Total:30
REFERENCES/ MANUAL /SOFTWARE:	
1.	Physics Laboratory Manual / Record, Department of Physics, 1st Edition, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	determine the rigidity modulus of a wire, the variation of variation of current and voltage in a series LCR circuit or the frequency of an alternating current and the velocity of ultrasound in a liquid.	Applying (K3), Precision (S3)
CO2	compute the acceptance angle and the numerical aperture of an optical fiber, the I-V characteristics of a p-n diode or the Hall coefficient of a material, the band gap of semiconductor materials.	Applying (K3), Precision (S3)
CO3	determine the wavelength of a laser, the particle size of a powder material, the specific resistance of a given wire, the thickness of a thin film and develop a coding / project / product.	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3					2	2		2	2	
CO2	3	2	2	3					2	2		2	2	
CO3	3	2	2	3					2	2		2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MEL11 - ENGINEERING PRACTICES LABORATORY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1/ 2**	**ES**	**0**	**0**	**2**	**1**

Preamble	This course is designed to provide a hands-on experience in basic of mechanical and electrical engineering practices.

LIST OF EXPERIMENTS / EXERCISES:

	PART A – MECHANICAL ENGINEERING
1.	Prepare a Square / Rectangular / V-Shape Projection with its Counterpart for Mating and Perform the Drilling, Tapping, and Assembling Tasks from the given Square / Rectangular MS Plates using Modern Power Tools.
2.	Prepare T / L / Lap Joint from given Wooden Work Piece and Make a Box / Tray out of Plywood using Modern Power Tools.
3.	Perform the Thread Formation on a GI/PVC Pipe and Prepare a Water Line from the Overhead Tank that is Leak-Proof.
4.	Make a Butt / Lap / Tee Joint of MS Plate using Arc Welding Process and Welding Simulator.
5.	**Activity:** Prepare an Innovative Model with the Knowledge from Fitting / Carpentry / Plumbing / Welding Involving Modern Power Tools.
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
6.	Wiring circuit for fluorescent lamp and Stair case wiring
7.	Wiring Circuit of Incandescent lamp using Impulse Relay
8.	Measurement of Earth Resistance
9.	Soldering of Simple Circuits and trouble shooting
10.	Implementation of half wave and full wave Rectifier using diodes
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Engineering Practices Laboratory Manual.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	plan the sequence of operations for effective completion of the planned models / innovative articles	Creating (K6) Manipulation (S2)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3) Manipulation (S2)
CO3	perform house wiring and realize the importance of earthing	Applying (K3), Manipulation (S2)
CO4	soldering with simple electronics circuits	Applying (K3), Manipulation (S2)
CO5	trouble shoot the electrical and electronic circuits	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		3	1	3	1			3	3		3		

CO2	3		3	1	3				3	3		3		
CO3	3		3	2	1				2	2		3	3	2
CO4	3		2	1	1				2	3		3	3	2
CO5	3		3	2	1				2	2		3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22VEC11 - YOGA AND VALUES FOR HOLISTIC DEVELOPMENT

(Common to All Engineering and Technology Branches)

Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**1**	**1**

Preamble	Yoga or yogasanas are considered as art and science of healthy living by our ancient gurus. It is method to bring harmony of body and mind for general wellbeing. Yoga is considered as one of the greatest gifts to the world by Indians for healthy living. Students in particular are benefitted by learning yoga.	
Unit – I	**Introduction:**	**2**
The Origins of Yoga – Definitions - Concepts - Aims and objectives of Yoga – Yoga is a Science and Art – Rules and Regulations of Asanas – Classifications of Yogasanas – Patanjali's Ashtanga Yoga – Pranayama – Mudras & Bandhas - Shatkarma (Cleansing Practice) - Streams of Yoga – Modern Trends in yoga.		
Unit – II	**Yoga and Mind:**	**2**
The Nature of Mind - Five Elements and the Mind - Meditation and the Mind - Functions of the Mind - Role of Yoga in Psychological problems: Mood Disorders, Major Depressive Disorder, Cyclothymic Disorder.		
Unit – III	**Yoga and Values, Diet:**	**2**
Human Values – Social Values – Role of Yoga in Personality Integration - Concepts of Natural Diet - Naturopathy Diet – Eliminative Diet – Soothing Diet – Constructive Diet.		
Unit – IV	**Asanas:**	**2**
Prayer - Starting & Closing - Preparatory practices – Loosening Practices – Meaning, Definitions and Objectives of Asanas - Principles of Practicing Asanas. Asanas: Standing – Sitting – Prone – Supine – Suryanamaskar.		
Unit – V	**Pranayama and Meditation:**	**2**
Breathing Practices for awareness - Definitions and Objectives of Pranayama - Principles of Practicing Pranayama. Pranayama: Nadi Shuddhi - Kapalabathi – Sitali – Sitkari – Bhranari – Ujjayi – Relaxation Techniques – Meditation.		
		Lecture: 10, Practical: 10, Total:20

TEXT BOOK:

1.	Swami satyananda saraswathi, "Asana pranayama mudra bandha", Bihar school of yoga, 4th Edition, 1969.
2.	Swami mukthi Bodhanandha, "Hatha yoga pradipika", Bihar school of yoga, 4th Edition, 1985.

REFERENCES:

1.	B.K.S. Iyenkar, "Yoga the path of holistic health", DK Limited, 2nd Edition, 1969.
2.	Selvarasu, "Kriya cleansing in yoga", Aruvi yoga, 3rd Edition, 2002.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	realize the importance of yoga in physical health.	Applying (K3)
CO2	realize the importance of yoga in mental health.	Applying (K3)
CO3	realize the role of yoga in personality development and diet.	Applying (K3)
CO4	do the loosening practices, Asanas and realize its benefits.	Applying (K3)
CO5	do the practice of Pranayama, meditation and realize its benefits	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3		2	1			
CO2						3		2				
CO3						3		3				
CO4						3		2	3			
CO5						3		3				

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	20	30	50	-	-	-	100
ESE	-	-	-	-	-	-	-

* ±3% may be varied (CAT3 – 100 marks)

22TAM01 - தமிழர் மரபு							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**0**	**1**

Preamble	தமிழர்களின் மொழி, இலக்கியம், ஓவியங்கள், சிற்பக்கலைகள், நாட்டுப்புறக் கலைகள், வீர விளையாட்டுக்கள், திணைக் கோட்பாடுகள், இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பைப் பற்றிய அறிவை வழங்குவதே இந்த பாடத்தின் நோக்கமாகும்.	
அலகு – I	**மொழி மற்றும் இலக்கியம்**	**3**
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
அலகு – II	**மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**	**3**
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.		
அலகு – III	**நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுக்கள்**	**3**
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.		
அலகு – IV	**தமிழர்களின் திணைக் கோட்பாடுகள்**	**3**
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு- சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.		
அலகு – V	**இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**	**3**
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.		
		Total: 15

TEXT BOOK:

1.	ஆ. பூபாலன், தமிழர் மரபு, VRB Publishers Pvt Ltd, 2022.

REFERENCES:

1.	தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		**BT Mapped (Highest Level)**
CO1	தமிழ் மொழி மற்றும் இலக்கியத்தில் மதிப்புமிக்க கருத்துக்களை விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் சிற்பம் மற்றும் அவர்களின் ஓவியங்கள் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்புக் கலைகளைப் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் திணைக் கோட்பாடுகளைப் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி விளக்க முடியும்.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks)

22TAM01 - HERITAGE OF TAMILS							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**0**	**1**

Preamble	The objective of this course is to impart knowledge about Tamil language, literature, paintings, sculptures, folk arts, heroic games, doctrines, contribution of Tamils to Indian culture.	
UNIT I	**Language and Literature**	**3**
Language families in india - dravidian languages – tamil as a classical language - classical literature in tamil – secular nature of sangam literature – distributive justice in sangam literature - management principles in thirukural - tamil epics and impact of buddhism & jainism in tamil land - bakthi literature azhwars and nayanmars - forms of minor poetry - development of modern literature in tamil - contribution of bharathiyar and bharathidhasan.		
UNIT II	**Heritage - Rock Art Paintings to Modern Art – Sculpture**	**3**
Hero stone to modern sculpture - bronze icons - tribes and their handicrafts - art of temple car making - - massive terracotta sculptures, village deities, thiruvalluvar statue at kanyakumari, making of musical instruments - mridhangam, parai, veenai, yazh and nadhaswaram - role of temples in social and economic life of tamils.		
UNIT III	**Folk and Martial Arts**	**3**
Therukoothu – karagattam - villu pattu - kaniyan koothu – oyillattam - leather puppetry – silambattam – valari - tiger dance - sports and games of tamils.		
UNIT IV	**Thinai Concept of Tamils**	**3**
Flora and fauna of tamils & aham and puram concept from tholkappiyam and sangam literature - aram concept of tamils - education and literacy during sangam age - ancient cities and ports of sangam age - export and import during sangam age - overseas conquest of cholas.		
UNIT V	**Contribution of Tamils to Indian National Movement and Indian Culture**	**3**
Contribution of tamils to indian freedom struggle - the cultural influence of tamils over the other parts of india – self-respect movement - role of siddha medicine in indigenous systems of medicine – inscriptions & manuscripts – print history of tamil books.		
		Total: 15

TEXT BOOK:

1.	S.Muthuramalingam, M.Saravanakumar, Heritage of Tamils, Yes Dee Publishing Pvt Ltd, 2023.

REFERENCES:

1.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies).
2.	The Contribution of Tamil of the Tamils to Indian Culture(Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
3.	Keeladi – 'Sangam City C ivilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu).

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain valuable concepts in language and literature of tamils.	Understanding (K2)
CO2	illustrate about the tamils sculpture and their paintings.	Understanding (K2)
CO3	summarize about the tamils folk and martial arts.	Understanding (K2)
CO4	explain the thinai concept of tamils.	Understanding (K2)
CO5	explain the contribution of Tamils to the Indian National Movement and Indian culture.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks)

22TAM02 – தமிழரும் தொழில்நுட்பமும்								
(Common to All Engineering and Technology Branches)								
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

முன்னுரை	தமிழ் கலாச்சாரத்தோடு ஒன்றிய தொழில் நுட்பங்களை பற்றிப் எடுத்துரைத்தல்

அலகு – I	**நெசவு மற்றும் பானை தொழில்நுட்பம்**	**3**
சங்க காலத்தில் நெசவு தொழில் – பானைத் தொழில்நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் – பாண்டகளில் கீறல் குறியீடுகள்		
அலகு – II	**வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**	**3**
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச்சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் –மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னை இந்தோ-சாரோசெனிக் கட்டிடக் கலை.		
அலகு – III	**உற்பத்தித் தொழில்நுட்பம்**	**3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் – கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு – IV	**வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்**	**3**
அணை, ஏரி, குளங்கள், மதகு – சோழர்கால குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
அலகு – V	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**	**3**
அறிவியல் தமிழின் வளர்ச்சி – கணினிதத்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்.		
		Total:15

TEXT BOOK:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016

REFERENCES:

1.	கீழடி-வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)

2.	பொருநை-ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
3.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
4.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamil to Indian Culture (Dr.M.Valarmathi) (Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		BT Mapped (Highest Level)
CO1	தமிழ் கலாச்சாரம் மற்றும் தமிழ் சமூகத்தினுடைய நெசவு மற்றும் பானை தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் உற்பத்தித் தொழில்நுட்பம் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	தமிழர்களின் அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் பற்றி விளக்க முடியும்.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

*** ±3% may be varied (CAT 1,2,3 – 50 marks)**

22TAM02 - TAMILS AND TECHNOLOGY								
(Common to All Engineering and Technology Branches)								
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

Preamble	This course aims to impart the essential knowledge on the tamil culture and related technology	
UNIT – I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads –Terracotta beads –Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.		
UNIT – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total:15

TEXT BOOK:	
1.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).
REFERENCES:	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016
3.	கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamils to Indian Culture (Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (dr.K.K.Pillay) (Published by : The Author)

9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain weaving and ceramic technology in tamil culture and tamil society.	Understanding (K2)
CO2	Illustrate about the design and construction technology.	Understanding (K2)
CO3	summarize about the manufacturing technology.	Understanding (K2)
CO4	explain the agriculture and irrigation technology.	Understanding (K2)
CO5	explain the significance of tamil in scientific and computing.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

*** ±3% may be varied (CAT 1,2,3 – 50 marks)**

22MAT33 - TRANSFORMS AND PROBABILITY THEORY							
Programme & Branch	**BE & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**BS**	**3**	**1**	**0**	**4**

Preamble	To provide the foundations for understanding the various types of transforms for analyzing different types of signals and impart knowledge in random variables, probability distributions and random process.

Unit – I	**Fourier Series and Fourier Transform:**	**9+3**
Exponential form of Fourier series analysis – Gibbs phenomenon –Fourier Transform: CTFT – Properties – Response of LTI CT systems – Inverse Fourier Transform for CT Signals.		
Unit – II	**Laplace Transform:**	**9+3**
Introduction – Relation between CTFT and LT- Region of Convergence – LT of CT signals – Properties of Laplace Transform – Finding Laplace Transform – Inverse Laplace Transform: Partial Fraction Expansion Method – Convolution Theorem – Response of Linear time invariant Continuous time system using Laplace transform.		
Unit – III	**Z transform:**	**9+3**
Introduction – Relation between DTFT and ZT – Region of Convergence – Z Transform of DT signals – Properties – Finding Z Transform and Inverse Z-transform: Partial fraction – Residue method.		
Unit – IV	**Random Variables and Probability distributions:**	**9+3**
Random Variables - Discrete and Continuous random variables – Probability mass and density functions – Mean and Variance – Standard Probability Distributions: Discrete Distributions: Binomial distribution – Poisson distribution – Continuous Distributions: Exponential distribution – Normal distribution – Two Dimensional Random Variables: Joint probability distributions – Marginal and conditional distributions.		
Unit – V	**Random Process:**	**9+3**
Introduction – Classification – Stationary process – Markov chains – Transition probabilities – Limiting distributions – Poisson process.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Nagoor Kani A., "Signals and Systems", 20th Reprint, McGraw Hill Education, Chennai, 2018. (Units I – III)
2.	Veerarajan, T, "Probability and Statistics, Random Processes and Queuing Theory", 1st Edition, McGraw Hill Education, Chennai, 2019. (Units IV, V)

REFERENCES:

1.	Oppenheim Alanv, Willsky Alan S., Hamid Nawab S., "Signals & Systems", 2nd Edition, Pearson Education, New Delhi, 2015.
2.	Roberts M.J., "Signals And Systems Analysis Using Transform Method and Matlab", 3rd Edition, Tata McGraw Hill Education, New Delhi, 2018.
3.	Stark H and Woods J W, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, 2002.
4.	Yates R D, and Goodman D J., "Probability and Stochastic Processes", 3rd Edition, Wiley India Pvt. Ltd, Bengaluru, 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the concept of Fourier transform and its properties which will provide the ability to formulate and solve some of the physical problems in engineering.	Applying (K3)
CO2	utilize Laplace transform and solve continuous time system response.	Applying (K3)
CO3	apply Z-transform on discrete time systems and solve the system response.	Applying (K3)
CO4	understand the fundamental concepts of random variables and apply suitable probability distributions in engineering problems.	Applying (K3)
CO5	understand the concepts of Random Process and determine the temporal characteristics of random signals.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		3	3							3	
CO2	3	2	2		2	2							2	
CO3	3	3	2		2	2							2	
CO4	3	2	1										1	
CO5	3	3	3										3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	25	65				100
CAT2	10	25	65				100
CAT3	10	25	65				100
ESE	10	25	65				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22ITC31 - JAVA PROGRAMMING							
(Common to ECE,EEE,EIE,MTS Engineering Branches)							
Programme & Branch	**ECE, EEE, EIE, MTS**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Problem Solving and Programming in C**	**3**	**ES**	**3**	**0**	**2**	**4**
Preamble	This course provides the fundamental object-oriented concepts of Java programming including inheritance, exception handling, multithreading, Generics, and Collections.						
Unit – I	**Classes and Objects**						**9**
History and Evolution of Java – An Overview of Java–Data Types, Variables and Arrays– Operators –Control Statements– Classes: Class Fundamentals-objects – Assigning Object Reference Variables – Introducing Methods –Constructors – this keyword – Garbage Collection – Stack Class.							
Unit – II	**Inheritance, Packages, and Interfaces**						**9**
Overloading Methods – Objects as Parameters –Argument Passing – Returning Objects –Recursion–Access Control–Static – Nested and Inner Classes–Command–Line Arguments – Variable Length Arguments. Inheritance – Basics– Super keyword - Multilevel Hierarchy-Method Overriding–Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages and Member Access- Importing Packages – Interfaces.							
Unit – III	**Exception Handling and Multithreading**						**9**
Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User-defined Exception. Multithreaded Programming: Java Thread Model - Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending – Resuming, and Stopping Threads –Multithreading.							
Unit – IV	**I/O and Generics**						**9**
Enumerations – Wrappers – Auto boxing – Annotation Basics. I/O Basics – Reading and Writing Console I/O –Reading and Writing Files. Generics: Introduction – Generic Classes & Methods - Example–Parameters, Constructors and Interfaces							
Unit – V	**String Handling and Collections**						**9**
String Handling: String constructors – operations – Character Extraction – String Comparison – Searching Strings – Modifying Strings – String Buffer. Collection Framework: Overview – Collection Interfaces – Collection Classes.							

LIST OF EXPERIMENTS / EXERCISES:

1.	Write Java programs using operators, arrays, and control statements
2.	Develop a stack and queue data structures using classes and objects
3.	Program to demonstrate inheritance & polymorphism
4.	Develop an application using interfaces by accessing superclass constructors and methods
5.	Develop applications using packages and exception handling
6.	Program to demonstrate thread concepts
7.	Write Java program to illustrate file and string manipulations
8.	Implement Java program to illustrate collection frameworks

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019. (Units I - V)

REFERENCES/ MANUAL / SOFTWARE:

1.	Cay S. Horstmann, "Core Java Fundamentals", Eleventh Edition, Prentice Hall, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concepts of classes and objects to solve simple problems	Applying (K3)
CO2	develop programs using inheritance, packages, and interfaces	Applying (K3)
CO3	make use of exception-handling mechanisms and multithreaded models to solve real-world problems	Applying (K3)
CO4	develop Java applications with I/O packages and generics concepts	Applying (K3)
CO5	apply string handling functions and collection classes and interfaces	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

* ±3% may be varied (CAT 1 & 2 – 60 marks & ESE – 100 marks)

22ECT31 - DIGITAL ELECTRONICS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	To gain knowledge about the number systems and to design combinational and sequential logic circuits.	
Unit – I	**Binary Numbers and Minimization Techniques:**	**9**
Complements-Signed binary numbers- Binary arithmetic- Boolean postulates and laws - De-Morgan‘s theorem - Principle of Duality- Boolean expression- Minimization of Boolean expressions- Minterm, Maxterm, Sum of Products (SOP), Product of Sums(POS)- Karnaugh map minimization -Implementations of logic functions using universal gates.		
Unit – II	**Combinational Circuits Design:**	**9**
Design procedure – Half adder and subtractor – Full adder and subtractor -Parallel binary adder and subtractor – Carry look ahead adder -BCD adder- Multiplexer- Demultiplexer – Decoder - Encoder – Parity checker and generator – Code converters- Magnitude comparator.		
Unit – III	**Hardware Description Language:**	**9**
Verilog Basics - Overview of Verliog HDL-Modules and ports-Gate level modeling- design of combinational circuits using Verilog HDL. Comparison of TTL and CMOS characteristics.		
Unit – IV	**Sequential Circuits:**	**9**
Introduction, Flipflops: SR, JK, D and T –Level and Edge triggering - Realization of one flipflop using other flipflops- Design of synchronous counters-up counter, down counter, up-down counter, Ripple counters – Registers: Shift registers, Universal shift register.		
Unit – V	**Design and analysis of Sequential Circuits:**	**9**
Design and analysis of synchronous sequential circuits: Characteristic, excitation tables and equations, State diagram, State table, State minimization and State assignment - Sequence detector - Introduction to asynchronous circuits -Cycles – Races –Hazards: Static Dynamic, Essential, Hazards elimination - Realization of combinational logic circuits using PLDs: PROM, PLA and PAL.		
		Total:45

TEXT BOOK:

1.	Morris Mano M., "Digital Design", 6th Edition, Pearson Education Pvt. Ltd., New Delhi, 2018, for Units I,II,IV,V.
2.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, New Delhi, 2017 for Unit III

REFERENCES:

1.	Floyd T L, “Digital Fundamentals”,11th Edition, Pearson Education, New Delhi, 2015.
2.	Salivahanan S. & Arivazhagan S., "Digital Circuits and Design", 5th Edition, Oxford University Press, New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply Boolean laws and Karnaugh map for logic minimization	Applying (K3)
CO2	design combinational circuits	Applying (K3)
CO3	construct combinational circuits using HDL	Applying (K3)
CO4	design sequential circuits	Applying (K3)
CO5	realize Boolean functions using PLDs	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2								2	2	2
CO2	3	2	2	2	2				2			2	3	2
CO3	3	2	2	2	3				3			2	3	2
CO4	3	2	2	2								2	3	2
CO5	3	2	2	2								2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	5	25	70				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT32 - ELECTRONIC CIRCUITS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Physics for Electronics and Communication Engineering**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	To understand the biasing circuits and analyze feedback amplifiers, large signal amplifiers and oscillators.	
Unit – I	**Diode and Thyristors:**	**9**
Construction of PN junction diodes – VI characteristics – Zener diode – Characteristics of Zener diode -Half wave and Full wave bridge rectifiers using diodes- Zener diode regulator- Line Regulation and load regulation – SCR -UJT		
Unit – II	**BJT and Biasing Circuits:**	**9**
BJT - Construction and Principle of Operation CE,CB and CC configurations - Transistor biasing: Need, operating point, concept of DC load line, fixed bias, self bias, voltage divider bias – Stability factors – Method of stabilizing the Q point(Derivation of S only) - Bias compensation techniques		
Unit – III	**BJT Amplifier Analysis:**	**9**
Midband analysis of BJT single stage amplifiers using h-parameters – Approximate and Exact Analysis - Miller's theorem- Transistor at high frequencies - Hybrid- π common emitter transistor model- CE short-circuit Current Gain		
Unit – IV	**Feedback Amplifiers:**	**9**
Feedback amplifiers - Block diagram - Loop gain - Gain and Cut off frequencies with Feedback – Effect of negative feedback - Four types of feedback topologies - Input and output resistances with feedback - Method of identifying feedback topology- Analysis of feedback amplifiers		
Unit – V	**Oscillators and Power Amplifiers:**	**9**
Oscillators: RC oscillators: RC phase shift and Wien Bridge oscillators - LC oscillators: Hartley and Colpitts oscillator using BJT, Quartz crystal oscillators, UJT relaxation oscillator Power Amplifiers: Classification of amplifiers (Class A, B, AB, and C)-Direct coupled and transformer-coupled class A power amplifiers and its efficiency-Distortion in power Amplifiers-Class B complementary-symmetry, push-pull power amplifiers. Class C amplifiers-operation-applications.		
		Total:45

TEXT BOOK:

1.	S Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", 5th Edition, McGraw-Hill, New Delhi, 2022. for Units I to IV
2.	Millman J. and Taub H., "Pulse Digital and Switching Waveform", 2nd Edition, McGraw Hill, New York, 2007 for Unit V

REFERENCES:

1.	Bell and David A, "Solid State Pulse Circuit", 4th Edition, Prentice Hall of India, New Delhi, 1992.
2.	Allen Mottershead, "Electronic Devices and Circuits - An Introduction", 1st Edition, Prentice Hall of India, New Delhi, 1990.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the construction and applications of diodes	Understanding (K2)
CO2	design various biasing circuits of BJT	Applying (K3)
CO3	examine the BJT amplifiers at low and high frequencies	Applying (K3)
CO4	Interpret the performance of amplifiers using feedback concepts	Applying (K3)
CO5	construct oscillator and power amplifier circuits	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2									2	1
CO2	3	2	3	2									2	1
CO3	3	3	2	2	3	2	2		2	2		2	2	1
CO4	3	3	2	1	3	2	2		2	2		3	2	1
CO5	3	3	3	1		2	2		2	2		2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	5	45	50				100
CAT2	5	45	50				100
CAT3	5	50	45				100
ESE	5	45	50				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECC31 - LINEAR INTEGRATED CIRCUITS

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Basics of Electronics and Electrical Engineering**	**3**	**PC**	**3**	**0**	**2**	**4**

Preamble	To understand and construct analog integrated circuits using op-amp, IC 555 and special function IC's.

Unit – I	**Operational Amplifiers:**	**9**
Internal block diagram of OP-AMP- Circuits for improving CMRR: Constant current sources, Widlar and Wilson current sources, Current repeaters. DC Characteristics of OP-AMP: Input bias current-Input offset current-Input offset voltage –Thermal drift. AC characteristics of OP-AMP: Frequency response- Frequency compensation methods –slew rate.		
Unit – II	**Applications of Operational Amplifier:**	**9**
Ideal Inverting and Non inverting Amplifiers-Adder-Subtractor-Instrumentation amplifier–Differentiator –Integrator – Comparators-Applications of Comparator: Zero Crossing Detector-Window Detector-Schmitt trigger-Sine wave generators: RC phase shift oscillator and Wien bridge oscillator.		
Unit – III	**Rectifiers, Active Filters and Regulators:**	**9**
First and Second order low pass and high pass filters. Rectifiers- Half wave rectifier- Full wave rectifier. Regulators- Voltage regulator IC: Series op-amp regulator (78XX), General Purpose regulator (IC 723)- Switching regulator.		
Unit – IV	**A/D Converter and D/A Converter:**	**9**
Analog to digital Converter: Flash type, Integrating type and Successive Approximation type-Digital to Analog converter: Weighted resistor type, R-2R ladder type and Inverted R-2R ladder type.		
Unit – V	**Special IC's:**	**9**
Timer (IC 555)- Functional block diagram –Astable and Monostable operation –Applications-Phase Locked Loop : block diagram-Derivation of capture and lock range –Phase detector: Analog phase detector and Digital phase detector –Voltage controlled Oscillator-Applications.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Construction of - Inverting and non-inverting amplifiers, Voltage Follower, Differentiator and Integrator using IC741
2.	Construction of Schmitt trigger using IC741
3.	Frequency response of 2nd order low pass and high pass filters using IC741
4.	Construction of voltage regulator using IC 78xx series
5.	Design and construct R-2R ladder type Digital to Analog Converter and Flash type Analog to Digital Converter
6.	Design of pulse width modulator using IC555
7.	MiniProject

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Roy Choudhry D & Shail B. Jain, "Linear Integrated Circuits", 5th Edition, New Age International, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:

1.	Gaykwad, Ramakant A, "OP-AMP and Linear IC", 4th Edition, PHI Learning, New Delhi, 2015.
2.	Salivahanan S & Kanchana Bhaaskaran V.S, "Linear Integrated Circuits", 3rd Edition, McGraw Hill Education, New Delhi, 2018.

3.	Laboratory Manual

	COURSE OUTCOMES: **On completion of the course, the students will be able to**	**BT Mapped (Highest Level)**
CO1	elaborate the need of various current sources for improving CMRR and understand the dc and ac characteristics of op-amp.	Understanding (K2), Precision (S3)
CO2	develop different applications of operational amplifiers for the given specification.	Applying (K3) , Precision (S3)
CO3	construct first and second order low pass and high pass filters, rectifiers and regulators using analog IC's	Applying (K3) , Precision (S3)
CO4	demonstrate the working of an ADC and DAC using IC 741.	Applying (K3), Precision (S3)
CO5	Illustrate the operation and applications of PLL and VCO using special function IC's	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3		2							3	3
CO2	3	3	3	2	3	2		2	2			2	2	2
CO3	3	2	3	3	3	2		2	2			2	2	2
CO4	3	3	3	2	3	2		2	2			2	2	2
CO5	3	3	3	3	3	2	2	2	2			2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	5	50	45				100
CAT2	5	40	55				100
CAT3	5	70	25				100
ESE	5	65	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GCT31- UNIVERSAL HUMAN VALUES							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**BS**	**2**	**0**	**0**	**2**

Preamble	To make the student to know what they 'really want to be' in their life and profession, understand the meaning of happiness and prosperity for a human being. Also to facilitate the students to understanding of harmony at all the levels of human living, and live accordingly	
Unit – I	**Introduction:**	**6**
Need and Basic Guidelines of Value Education – Content and Process of Value Education – Self Exploration – purpose of self-Exploration – Content and Process of Self exploration – Natural Acceptance – Realization and Understanding – Basic Human Aspirations – Continuous Happiness and Prosperity – Exploring Happiness and Prosperity – Basic Requirement for Fulfillment of Human Aspirations – Relationships – Physical Facilities – Right Understanding.		
Unit – II	**Harmony in the Self and Body:**	**6**
Human Being and Body – Understanding Myself as Co–existence of Self ('I') and Body, Needs of the Self and Body, Activities in the Self and Body, Self ('I') as the Conscious Entity, the Body as the Material Entity – Exercise – Body as an Instrument– Harmony in the Self ('I) – Understanding Myself – Harmony with Body.		
Unit – III	**Harmony in the Family and Society:**	**6**
Harmony in the Family – Justice – Feelings (Values) in Human Relationships – Relationship from Family to Society – Identification of Human Goal – Five dimensions of Human Endeavour.		
Unit – IV	**Harmony in Nature and Existence:**	**6**
Order of Nature – Interconnectedness – Understanding the Four order – Innateness – Natural Characteristic – Basic Activity – Conformance – Introduction to Space – Co–existence of units of Space – Limited and unlimited – Active and No–activity – Existence is Co–existence.		
Unit – V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics:**	**6**
Values in different dimensions of Human Living – Definitiveness of Ethical Human Conduct –Implications of Value based Living – Identification of Comprehensive Human Goal – Humanistic Education – Universal Human Order – Competence and Issues in Professional Ethics.		
		Total:30

TEXT BOOK:

1.	Gaur R.R., Sangal R., Bagaria G.P., "A Foundation Course in Human Values and Professional Ethics", 1st edition, Excell Books Pvt. Ltd., New Delhi, 2016.

REFERENCES:

1.	Ivan Illich, "Energy & Equity", The Trinity Press, USA, 1974.
2.	Schumacher E.F., "Small is Beautiful: a study of economics as if people mattered", Britain, 1973.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	restate the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	Applying (K3)
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self, the Co–existence of Self and Body	Applying (K3)
CO3	infer the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society	Applying (K3)
CO4	transform themselves to co-exist with nature by realising interconnectedness and four order of nature	Applying (K3)
CO5	distinguish between ethical and unethical practices, and extend ethical and moral practices for a better living	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	25	75					100
ESE	NA						100

* ±3% may be varied (CAT 1 & 2 – 60 marks & ESE – 100 marks)

22TAM01 - தமிழர் மரபு							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**HS**	**1**	**0**	**0**	**1**

Preamble	தமிழர்களின் மொழி, இலக்கியம், ஓவியங்கள், சிற்பக்கலைகள், நாட்டுப்புறக் கலைகள், வீர விளையாட்டுக்கள், திணைக் கோட்பாடுகள், இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பைப் பற்றிய அறிவை வழங்குவதே இந்த பாடத்தின் நோக்கமாகும்.

அலகு – I	**மொழி மற்றும் இலக்கியம்**	**3**

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு – II	**மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**	**3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு – III	**நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுக்கள்**	**3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு – IV	**தமிழர்களின் திணைக் கோட்பாடுகள்**	**3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு– சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு – V	**இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**	**3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Total: 15

TEXT BOOK:

1.	ஆ. பூபாலன், தமிழர் மரபு, VRB Publishers Pvt Ltd, 2022.

REFERENCES:

1.	தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		**BT Mapped (Highest Level)**
CO1	தமிழ் மொழி மற்றும் இலக்கியத்தில் மதிப்புமிக்க கருத்துக்களை விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் சிற்பம் மற்றும் அவர்களின் ஓவியங்கள் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்புக் கலைகளைப் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் திணைக் கோட்பாடுகளைப் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி விளக்க முடியும்.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks)

22TAM01 - HERITAGE OF TAMILS								
(Common to All Engineering and Technology Branches)								
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Nil**	**3**	**HS**	**1**	**0**	**0**	**1**	

Preamble	The objective of this course is to impart knowledge about Tamil language, literature, paintings, sculptures, folk arts, heroic games, doctrines, contribution of Tamils to Indian culture.	
UNIT I	**Language and Literature**	**3**
Language families in india - dravidian languages – tamil as a classical language - classical literature in tamil – secular nature of sangam literature – distributive justice in sangam literature - management principles in thirukural - tamil epics and impact of buddhism & jainism in tamil land - bakthi literature azhwars and nayanmars - forms of minor poetry - development of modern literature in tamil - contribution of bharathiyar and bharathidhasan.		
UNIT II	**Heritage - Rock Art Paintings to Modern Art – Sculpture**	**3**
Hero stone to modern sculpture - bronze icons - tribes and their handicrafts - art of temple car making - - massive terracotta sculptures, village deities, thiruvalluvar statue at kanyakumari, making of musical instruments - mridhangam, parai, veenai, yazh and nadhaswaram - role of temples in social and economic life of tamils.		
UNIT III	**Folk and Martial Arts**	**3**
Therukoothu – karagattam - villu pattu - kaniyan koothu – oyillattam - leather puppetry – silambattam – valari - tiger dance - sports and games of tamils.		
UNIT IV	**Thinai Concept of Tamils**	**3**
Flora and fauna of tamils & aham and puram concept from tholkappiyam and sangam literature - aram concept of tamils - education and literacy during sangam age - ancient cities and ports of sangam age - export and import during sangam age - overseas conquest of cholas.		
UNIT V	**Contribution of Tamils to Indian National Movement and Indian Culture**	**3**
Contribution of tamils to indian freedom struggle - the cultural influence of tamils over the other parts of india – self-respect movement - role of siddha medicine in indigenous systems of medicine – inscriptions & manuscripts – print history of tamil books.		
		Total: 15

TEXT BOOK:

1.	S.Muthuramalingam, M.Saravanakumar, Heritage of Tamils, Yes Dee Publishing Pvt Ltd, 2023.

REFERENCES:

1.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies).
2.	The Contribution of Tamil of the Tamils to Indian Culture(Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
3.	Keeladi – 'Sangam City C ivilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu).

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain valuable concepts in language and literature of tamils.	Understanding (K2)
CO2	illustrate about the tamils sculpture and their paintings.	Understanding (K2)
CO3	summarize about the tamils folk and martial arts.	Understanding (K2)
CO4	explain the thinai concept of tamils.	Understanding (K2)
CO5	explain the contribution of Tamils to the Indian National Movement and Indian culture.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks)

22ECL31 - DIGITAL ELECTRONICS LABORATORY							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	To design and implement combinational and sequential logic circuits.

LIST OF EXPERIMENTS / EXERCISES:

1.	Verification of digital logic gates
2.	Design and Implementation of Combinational Circuits using logic gates
3.	Design and Implementation of 4-bit adder/subtractor using MSI device.
4.	Design and simulate 4- bit ripple carry adder using Modelsim
5.	Design and simulate 4- bit BCD adder using Modelsim
6.	Design and implementation of flip flops using basic gates.
7.	Design and implement a MOD-4 counter using JK Flip Flop.
8.	MiniProject

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Modelsim

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	design and verify combinational circuits using logic gates	Applying (K3), Precision (S3)
CO2	design and simulate combinational Logic circuits using Verilog HDL	Applying (K3), Precision (S3)
CO3	design and verify Sequential Logic circuits using logic gates	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2				2	2		2	3	2
CO2	3	2	2	2	3	2			3	2		2	3	2
CO3	3	2	2	2	2				3	2		2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

22ECL32 - ELECTRONIC CIRCUITS LABORATORY							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites		**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	To design simple systems based on amplifiers, oscillators

LIST OF EXPERIMENTS / EXERCISES:

1.	Design of power supply unit for electronic gadgets
2.	Application of BJT as ON/OFF switch.
3.	Characteristics of UJT
4.	Frequency response of fixed bias/voltage divider bias/collector to base bias of BJT
5.	Design of audio and radio frequency oscillator(RC Phase Shift Oscillator & Hartley oscillator)
6.	Class -B Complementary symmetry Power amplifier-with and without crossover distortion
7.	Design of current series feedback amplifier
8.	Simulation of the following experiments using PSPICE i) Wien Bridge Oscillator ii) Colpitts Oscillator
9.	Mini Project to generate a waveform and improve its signal level
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Orcad Cadence PSPICE Software 16.6

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the application of various electronic devices	Applying (K3) , Precision(S3)
CO2	design of oscillators and large signal amplifiers	Applying (K3) , Precision(S3)
CO3	design and test the performance of biasing circuits, amplifiers and oscillators using electronic systems design tools	Applying (K3) , Precision(S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1		2	2	1		1	2	1
CO2	3	3	2	2	1	1		2	2	1		1	2	1
CO3	3	3	2	2	3	1		2	2	1		1	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22ITC41 - PROGRAMMING IN PYTHON							
(Common to ECE, EEE, EIE, MTS Engineering branches)							
Programme & Branch	**ECE, EEE, EIE, MTS**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Problem Solving and Programming in C**	**4**	**ES**	**3**	**0**	**2**	**4**
Preamble	This course introduces the core Python programming. It emphasizes developing Python programs with alldata types, functions, classes, objects, and NumPy						
Unit – I	**Introduction:**						**9**
Problem-solving strategies – program design tools – Types of errors – Testing and Debugging- Basics: Literals – variables and identifiers – data types - input operation – comments – reserved words – indentation – Operators and Expressions – Decision Control Statements: Introduction – conditional statement – iterative statements – Nested Loops – break, continue and pass statements — else in loops.							
Unit – II	**Lists, Tuples and Dictionary:**						**9**
Lists: Access, update, nested, cloning, operations, methods, comprehensions, looping - Tuple: Create, utility, access, update, delete, operations, assignments, returning multiple values, nested tuples, index, and count method - Dictionary: Create, access, add and modify, delete, sort, looping, nested, built-in methods — list vs tuple vs dictionary.							
Unit – III	**Strings and Regular Expressions:**						**9**
Strings: Concatenation, append, multiply on strings – Immutable – formatting operator – Built-in string methods and functions – slice operation – functions – operators – comparing – iterating – string module – Regular Expressions **–** match, search, sub, findall and finditer functions – flag options.							
Unit – IV	**Functions and Modules:**						**9**
Functions: Introduction - definition – call – variable scope and lifetime – return statement – function arguments – lambda function – documentation strings – programming practices recursive function- Modules: Modules – packages – standard library methods – function redefinition.							
Unit – V	**Object Orientation:**						**9**
Class and Objects: Class and objects – class methods and self – constructor – class and object variables – destructor – public andprivate data member. **NumPy:** NumPy Arrays – Computation on NumPy Arrays. **MatplotLib:** Line plots – Scatter Plots							

LIST OF EXPERIMENTS / EXERCISES:

1.	Programs using conditional and looping statements
2.	Implementation of list and tuple operations
3.	Implementation of dictionary operations
4.	Perform various string operations
5.	Use regular expressions for validating inputs
6.	Demonstration of different types of functions and parameter passing
7.	Develop programs using classes and objects
8.	Perform computation on NumPy arrays
9.	Draw different types of plots using Matplotlib

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Reema Thareja., “Python Programming using problem solving approach”, 3rd impression, Oxford University Press., New Delhi, 2017.

REFERENCES/ MANUAL / SOFTWARE:

1.	Nageswara Rao, “Core Python Programming”, 2nd Edition, DreamTech Press, New Delhi, 2018.
2.	Jake Vander Plas,” Python Data Science Handbook Essential Tools for Working with Data”, O’Reilly publishers,1st Edition, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	use basic Python constructs to build simple programs	Applying (K3), Precision (S3)
CO2	apply list, tuple, and dictionary to handle a variety of data.	Applying (K3), Precision (S3)
CO3	apply strings and regular expressions for searching and retrieval	Applying (K3), Precision (S3)
CO4	solve the problems using functions and modules.	Applying (K3), Precision (S3)
CO5	apply object-oriented concepts and perform basic data science operations using Python	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	15	75				100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	75				100

* ±3% may be varied (CAT 1 & 2 – 60 marks & ESE – 100 marks)

22ECT41 - DIGITAL SIGNAL PROCESSING							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transforms and Probability Theory**	**4**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course provides foundation for understanding the various types of signals and systems and also to design and analyze digital signal processing systems.	
Unit – I	**Signals (CT and DT):**	**9 + 3**
Standard CT and DT Signals – Classification of CTS and DTS –Mathematical operations on CTS and DTS. Systems: CT and DT systems-Classification of continuous time and discrete time systems		
Unit – II	**Analysis of Systems(CT and DT)**	**9 + 3**
Analysis of CT systems using Laplace transforms: Impulse response-Step response -Frequency response and output response of LTI - CT systems. Analysis of DT systems using Z-Transform: Impulse response-Step response-Frequency response and output response of LTI - DT systems		
Unit – III	**DFT and FFT:**	**9 + 3**
Review of DFT– Properties of DFT. Radix2-FFT (8-point) : Decimation in Time – Decimation in Frequency –Circular Convolution and Linear convolution- Overlap add and Overlap Save method. Applications: Analysis of frequency components in Music/Speech/Composite signals		
Unit – IV	**FIR and IIR Filter Design:**	**9 + 3**
FIR Filter Design : Response of FIR Filter-Group delay & phase delay (Concept only)-Causal Filter Design using :Rectangular –Hamming –Hanning- Blackmann Window. **IIR Filter Design** : Analog filter design: Butterworth filter and Chebyshev filters - Digital Transformation : Impulse invariance technique – Bilinear transformation		
Unit – V	**Finite Word Length Effect:**	**9 + 3**
Quantization noise – Derivation for quantization noise power –Truncation and rounding error – Input quantization error-Coefficient quantization error-Product quantization error – Limit cycle oscillations- Overflow error-Signal scaling		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Nagoor Kani, "Digital Signal Processing", 2nd Edition, McGraw-Hill, New Delhi, 2017.

REFERENCES:

1.	Oppenheim Alanv, Willsky Alan S., Hamid Nawab S., “Signals & Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.
2.	Roberts M.J., “Signals And Systems Analysis Using Transform Method and Matlab”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2018.
3.	Alan V. Oppenheim & Ronald W. Schafer, "Discrete Time Signal Processing", 2nd Edition, Pearson education, New Delhi, 2010
4.	Proakis John G &Manolakis Dimtris G, "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, PHI Learning, New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the continuous time and discrete time signals and systems	Applying (K3)
CO2	utilize Laplace transform, Z-transform and solve continuous time, discrete time system response	Applying (K3)
CO3	apply DFT and FFT to find frequency components in a signal.	Applying (K3)
CO4	design digital FIR and IIR filter for the given specification.	Applying (K3)
CO5	determine the effect of finite word length of infinite response.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2				2	2		2	3	
CO2	3	2	2	1	2				2	2		2	3	
CO3	3	2	2	2								2	3	
CO4	3	2	2	2					2			2	3	
CO5	3	2	2	2								2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70	-	-	-	100
CAT2	5	25	70	-	-	-	100
CAT3	5	25	70	-	-	-	
ESE	5	25	70	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT42 - MICROPROCESSOR AND MICROCONTROLLER							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**3**	**0**	**0**	**3**

Preamble	To understand the concepts of microprocessor and microcontrollers techniques and do programming for real time applications.	
Unit – I	**8086 Microprocessor:**	**9**
Register organization of 8086 – Architecture –Memory Segmentation- Physical memory organization - I/O addressing capability - Addressing modes of 8086 - Instruction set of 8086: Data transfer instructions - String instructions- Logical instructions - Arithmetic instructions - Transfer and control instructions - Processor control instructions.		
Unit – II	**8086 Microprocessor ALP Programming:**	**9**
Simple Assembly Language Programming - Introduction to stack - Interrupt and interrupt service routines-Time delays using counter.		
Unit – III	**89C51 Microcontroller:**	**9**
Introduction to RISC and CISC machines – 89C51 Microcontroller hardware block diagram - Data and program memory mapping - Register organization - I/O pins - Ports and circuits - Interfacing to external memory- Instruction sets - Addressing modes.		
Unit – IV	**89C51 Programming:**	**9**
Assembly language programming -Timer and counter programming – Serial Data Communication using MAX232 converter – Interrupt programming.		
Unit – V	**89C51 Case study:**	**9**
Traffic light Control: LED, 7 segment display-Digital locker: LCD, Matrix Keypad-Fire alarm System: ADC, LM35 sensor-Speed control of Conveyor Belt: DC motor, Stepper motor –Smart shoe for Physically Challenged.		
		Total:45

TEXT BOOK:

1.	Ray K., and Bhurchandi K. M., “Advanced Microprocessors and Peripherals: Architecture, Programming and Interface”, 3rd Edition, Tata McGraw Hill, New Delhi, 2012, ISBN: 9780070140622 for Units I and II.
2.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems using Assembly and C”, 2rd Edition, Pearson Education Pvt. Ltd, New Delhi, 2007 for Units III, IV and V.

REFERENCES:

1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, Lyla B. Das, “Microprocessors and Microcontrollers”, 1st Edition, Pearson Education, New Delhi, 2013.
2.	Patel, “The 8051 Microcontroller Based Embedded Systems”, 1st Edition, McGraw Hill Education, New Delhi, 2014, ISBN: 9789332901254.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the internal blocks and register organisation of 8086 microprocessor architecture	Understanding (K2)
CO2	use assembly language programming skill for arithmetic and logic operations using 8086 processor	Applying (K3)
CO3	describe the internal blocks of 89C51 microcontroller Architecture and interfacing external memory	Understanding (K2)
CO4	develop assembly language programming for internal modules of 89C51 controller	Applying (K3)
CO5	apply programming skills to interface external peripherals	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1										3	1	
CO2	3	2	1	1						2			3	
CO3	2	1										3	1	
CO4	3	2	1	1						2		2	3	1
CO5	3	2	1	1		2			1	2	1	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	55	25	-	-	-	100
CAT2	10	35	55	-	-	-	100
CAT3	10	35	55	-	-	-	100
ESE	4	44	52	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT43 - TRANSMISSION LINES AND WAVEGUIDES							
Programme & Branch	**B.E - Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Electromagnetic Fields**	**4**	**PC**	**3**	**0**	**0**	**3**

Preamble	To acquire the concepts of transmission line parameters and wave propagation in guided and waveguide structures	
Unit – I	**Transmission Line Parameters:**	**9**
A line of cascaded T sections - Transmission lines - General solution - Physical significance of the equations - the infinite line- Wavelength –Velocity —propagation - Distortionless line -The telephone cable - Reflection on a line not terminated in Zo - Reflection coefficient - Open and short circuited lines - Insertion loss.		
Unit – II	**The Line at Radio Frequency:**	**9**
Parameters of open wire line and Coaxial cable at RF - Line constants for zero dissipation -Voltages and currents on the dissipationless line -Standing waves -Nodes and antinodes- Standing wave ratio - Input impedance of the dissipationless line -Input impedance of open and short circuited lines -Power and impedance measurement on lines - The eighth wave- The quarter wave line- The Half wave line.		
Unit – III	**Stub Matching and Smith Chart:**	**9**
Stub Matching-Derivations of single stub impedance matching on a line-Smith circle diagram- Smith chart application: Plotting complex impedance- Admittance for given impedance- Input impedance of a TL terminated in a short or open - Input impedance of a TL at any distance from a load- Locating first maximum and minimum from any load- Matching a TL to a load with a parallel tuning stub.		
Unit – IV	**Guided Waves:**	**9**
Waves between parallel planes of perfect conductors- Field Equations: TE waves, TM waves - Characteristics of TE and TM waves - Attenuation of TE and TM waves in parallel plane guides - TEM Waves.		
Unit – V	**Waveguides and Resonators:**	**9**
Rectangular Waveguides: Field equations: TM waves, TE waves - Characteristic of TE and TM Waves - Impossibility of TEM waves - Dominant mode - Characteristic impedance - Excitation of modes. **Resonators:** Microwave cavity resonator - Rectangular cavity resonators - Q factor of a cavity resonator for TE101 mode.		
		Total:45

TEXT BOOK:

1.	Ryder J.D, "Networks Lines and Fields", 2nd Edition, Pearson Education, New Delhi, 2015, for Units I, II, & III
2.	Dr.P.Dananjayan,"Transmission Lines and Wave guides", Lakshmi Publications,2014, for Units IV & V

REFERENCES:

1.	Edwards C.Jordan, Keith G.Balman, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall, 2015 .
2.	Umesh Sinha, "Transmission Lines and Networks", 1st Edition, SatyaPrakasan, New Delhi, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	compute the parameters of transmission lines.	Understanding (K2)
CO2	determine the parameter of transmission line at radio frequency and the impedancevalue for different lengths of line	Understanding (K2)
CO3	Make use of Smithchart for design of transmission lines and Stub matching	Applying (K2)
CO4	compute the field equations, characteristics and performance parameters for guidedwaves	Understanding (K2)
CO5	determine the field equations, characteristics and performance parameters forrectangular waveguides and rectangular cavity resonators.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2				2					3	2
CO2	3	2	2	2				2					3	2
CO3	3	2	2	2				2					3	2
CO4	3	2	2	2				2					3	2
CO5	3	2	2	2				2					3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	90	-	-	-	-	100
CAT2	10	55	35	-	-	-	100
CAT3	10	90	-	-	-	-	100
ESE	10	70	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT44 - CONTROL ENGINEERING							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transforms and Probability Theory**	**4**	**PC**	**3**	**1**	**0**	**4**

Preamble	To understand the concepts of mathematical modeling of various systems and also to examine the system response and stability in both time and frequency domain.	
Unit – I	**System Representation:**	**9 + 3**
Basic elements in control systems – Open and closed loop systems – Modeling of Mechanical systems-Translational and Rotational Systems-Modeling of Electrical Networks- Electrical analogy of mechanical systems – Transfer function - DC Motors-Electromechanical system - Gear trains-Block Diagram Reduction-Signal Flow Graph.		
Unit – II	**Time Domain Analysis:**	**9 + 3**
Standard test signals- Time response of First and Second order system response- Time domain specifications – Error coefficients – Steady state error- Generalized error series –Introduction to P, PI, PID controllers - Effect of P, PI, PID controllers on time response.		
Unit – III	**Stability Analysis in time Domain:**	**9 + 3**
Characteristics Equation – Location of Roots in S plane for stability – Routh Hurwitz Criterion – Root Locus construction – Effect of poles and zeros on system stability.		
Unit – IV	**Frequency Response Analysis:**	**9 + 3**
Frequency response – Correlation between frequency domain and time domain specifications -Bode plot – Polar plot –Stability Analysis in Frequency Domain-Nyquist Stability Criteria-Introduction to Compensators.		
Unit – V	**State Space Representation:**	**9 + 3**
Introduction to state space analysis - Phase variable and canonical forms - State transition matrix - Solutions to state space equation - Controllability and Observability of systems-Kalman test for Controllability and Observability.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Nagrath I.J &Gopal M, "Control Systems Engineering", 5th Edition, New Age International , New Delhi, 2013,

REFERENCES:

1.	Norman S Nise, "Control Systems Engineering", 5th Edition, Wiley-India Publishers, New Delhi, 2017.
2.	Gopal M, "Control Systems; Principles and Design", 4th Edition, McGraw-Hill, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	develop mathematical models for various types of control systems.	Applying (K3)
CO2	determine the time response of first and second order controllers.	Applying (K3)
CO3	verify the stability of the systems in time domain.	Applying (K3)
CO4	make use of plots to interpret the stability of systems in frequency domain.	Applying (K3)
CO5	apply various tests to find the controllability and observability for various systems.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1								2	3	
CO2	3	3	2	2	2								3	
CO3	3	3	2	2	2				2	2		2	3	
CO4	3	3	2	2	2				2	2		2	3	
CO5	3	2	1	1									3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	05	35	60	-	-	-	100
CAT2	05	25	70	-	-	-	100
CAT3	05	25	70	-	-	-	100
ESE	05	25	70	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECL41 - DIGITAL SIGNAL PROCESSING LABORATORY							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**

Preamble	To simulate and analyze the frequency components of a signal, digital filters and its implementation

LIST OF EXPERIMENTS / EXERCISES:

1.	Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc using MATLAB and Simulink
2.	Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power using MATLAB and Simulink
3.	Perform waveform synthesis using Laplace transform and Z-transform of a given signal. Also locate zeros, poles. Also plot pole zero map in S plane and Z plane for a given transfer function
4.	Perform linear convolution and Circular convolution using MATLAB
5.	Consider an audio signal and convert this into discrete time signal. Also compute the Discrete Fourier Transform and IDFT in MATLAB
6.	FIR Filter design and its analysis with the Windowing method using MATLAB
7.	Digital IIR Filter design and its analysis using impulse invariant method and bilinear transformation technique using MATLAB
8.	FIR and IIR Filter design using Simulink
9.	Audio loopback using interrupt and polling method with TMS320C67XX processor.
10.	Miniproject

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	MATLAB
3.	Code Composer Studio.
4	TMS320C67XX DSP processor datasheet

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	simulate various continuous and discrete time signals	Applying(K3), Precision (S3)
CO2	design FIR digital filter and IIR digital filter for the given specification	Applying(K3), Precision (S3)
CO3	perform real time signal acquisition and processing in DSP processor	Applying(K3), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3				3		2		3	1
CO2	3	2	3	3	3				3		2		3	1
CO3	3	2	3	3	3	3	2		3		2		3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22ECL42 - MICROPROCESSOR AND MICROCONTROLLER LABORATORY							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**

Preamble	To do programming using 8086 and 89C51

LIST OF EXPERIMENTS / EXERCISES:

1.	Arithmetic operations using 8086 microprocessor
2.	Sorting and searching manipulation using 8086 MICROPROCESSOR
3.	Arithmetic operations using 89C51 microcontroller
4.	Object counter with 7-segment display and digital sensor using 89C51 microcontroller
5.	Digital locker with LCD and Keypad using 89C51 microcontroller.
6.	Conveyer belt movement using Stepper motor with 89C51 microcontroller
7.	Fire alarm system using 89C51 microcontroller

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Keil and Proteus software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply 8086 and 8051 instruction sets and addressing modes for a given addition / Subtraction / Multiplication / Division / searching and sorting programs	Applying (K3), Precision (S3)
CO2	build LED , Switch , ADC, DAC, Stepper motor and DC Motor interfaces with 8051 Microcontroller	Applying (K3), Precision (S3)
CO3	demonstrate the working model/project using 8051 Microcontroller	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3								3	2		2		
CO2	3	1	3						3	2		2	3	1
CO3	3		3		1				3	2		2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22EGL31 - COMMUNICATION SKILLS DEVELOPMENT LABORATORY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**HS**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.

LIST OF EXPERIMENTS / EXERCISES:	
1.	Self Introduction & Mock Interview
2.	Job Application letter with Resume
3.	Presentation: A Technical topic / Project report & a Case study
4.	Situational Dialogues / Telephonic Conversations
5.	Group Discussion
6.	Reading Aloud
7.	Listening Comprehension
8.	Writing Company Profiles
9.	Preparing reviews of a book/product/movie
10.	Pronunciation Test
	Total: 30

REFERENCES/ MANUAL /SOFTWARE:	
1.	Laboratory Manual
2.	Orell Digital Language Lab Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	enhance effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2	acquire professional skills required for workplace/higher education	Applying (K3), Naturalization (S5)
CO3	use English language skills effectively in various situations	Applying (K3), Articulation (S4)

Mapping of COs with POs and PSOs

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1									2	3		3
CO2									2	2		2
CO3									2	2		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22GEL41 - PROFESSIONAL SKILLS TRAINING - I							
(Common to All BE/ BTech Engineering and Technology branches)							
Programme & Branch	**All BE/ BTech Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	EC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit – I	**Soft Skills – I :**	**20**
Soft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for change-Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous knowledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business etiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone etiquette- Body Language.		
Unit – II	**Quantitative Aptitude and Logical Reasoning – I:**	**30**
Problem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and variation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree- Deductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement		
Unit – III	**Written Communication & Verbal Aptitude**	**30**
Writing Skills: Writing strategies and formats Importance of Résumés Writing a Cover letter -Responding to Job Advertisements Professional e-mail Writing Responding to e-mails and business letters Technical Report writing Interpretation of Technical Data (Transcoding) Writing One-page Essays. Verbal Aptitude Synonyms Antonyms Homonyms One word substitution Idioms and Phrases Paired words Analogies Spelling test Cloze test using suitable verb forms using appropriate articles and prepositions; Spotting Errors Sentence Correction and Formation Grammar Based questions (Transformation : Active-Passive & Direct-Indirect); Rearranging Jumbled Sentences & Jumbled paragraphs, Identifying Facts, Inferences and Judgements statements		
		Total:45

TEXT BOOK:

1.	Edgar Thorpe and Showick Thorpe, “Objective English for Competitive Examination”, 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1.	Stephen Bailey, “Academic Writing: A practical guide for students”, Routledge, New York, 2011.
2.	Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individualand as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	Apply communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						100

* ±3% may be varied (CAT 1,2,3 - 50 marks)

22ECT51 - VLSI DESIGN							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Electronics**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	To impart global understanding of Verilog Hardware Description Language and MOS transistor characteristics, fabrication and testing of ICs.	
Unit – I	**Verilog HDL:**	**9**
Data flow modeling –Behavioral modeling - Structured procedures- Procedural assignments- Timing controls – Delay control- Event control - Conditional statements- Multiway branching – Loops- Switch level modeling.		
Unit – II	**Logic Synthesis and RTL Design:**	**9**
Logic Synthesis : Impact of logic synthesis- Verilog HDL synthesis- Synthesis design flow – Verification of gate level netlist- Modeling tips for logic synthesis- RTL design : 4-bit full adder subtractor- ALU design – Booth multiplication		
Unit – III	**MOS Transistor:**	**9**
CMOS logic- MOS transistor theory- Long channel I-V characteristics- C-V characteristics- Non-ideal I-V effects- DC characteristics - Noise margin - Power dissipation - Switching characteristics.		
Unit – IV	**MOS Fabrication:**	**9**
An overview of silicon semiconductor technology - Basic CMOS technology: N-well, P-well, Twin tub and SOI process- Latch up and prevention- Layout Design rules- Stick diagram- Layout diagram for basic logic gates- Introduction to static CMOS- Pseudo nMOS logic -dynamic CMOS-Cascade Voltage Switch Logic.		
Unit – V	**CMOS Testing:**	**9**
Introduction to testing- Logic verification principles- Test vectors-Manufacturing test principles - Fault models- Observability, Controllability - Fault coverage – DFT- Ad-Hoc testing - Scan design – BIST- D-algorithm and Boolean difference method.		
		Total:45

TEXT BOOKS:

1.	Palnitkar Samir, "Verilog HDL: A Guide to Digital Design and synthesis", 2nd Edition, Pearson Education, New Delhi, 2017, for Units I, II.
2.	Neil Weste & David Harris, "CMOS VLSI Design-A circuits & System Perspective", 4th Edition, Pearson education, New Delhi, 2019, for Units III, IV, V.

REFERENCES:

1.	Pucknell, Douglas A & Eshragian K, "Basic VLSI Design", 3rd Edition, PHI Learning, New Delhi, 2012
2.	Rabaey J. M, Chandrakasan A & Nikolic B, "Digital integrated circuits: a design perspective", 2nd Edition, PHI Learning, New Delhi, 2003.
3.	Ajay Kumar Singh , "Digital VLSI Design", 1st Edition, PHI Learning, 2011

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	develop digital logic circuits and VLSI systems using Verilog Hardware Description Language Programming.	Applying (K3)
CO2	illustrate the components in the logic synthesis-based design flow.	Applying (K3)
CO3	elaborate the characteristics of MOS transistor.	Understanding (K2)
CO4	make use of techniques for IC fabrication, layout design rules to draw layout of logic functions and to design circuits using various logic styles.	Applying (K3)
CO5	interpret the testing techniques/algorithms to test the circuits	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3				2			2	3	3
CO2	3	3	3		3				2			2	3	3
CO3	3	3	2		2				2			2	3	2
CO4	3	3	2		2				2			2	3	3
CO5	3	3	2		2				2			3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	35	50	-	-	-	100
CAT2	15	70	15	-	-	-	100
CAT3	15	50	35	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT52 - ANALOG AND DIGITAL COMMUNICATION								
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Signal Processing, Electronic Circuits**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	To endow the fundamentals and analytical perspectives of communication systems.	
Unit – I	**Amplitude Modulation:**	**9**
Introduction: Modulation and its need– Linear modulation schemes: DSBSC, SSBSC and VSB- spectrum – Frequency translation – Frequency division multiplexing – Superheterodyne receivers – Noise in AM receivers: Coherent detection, envelope detection		
Unit – II	**Angle Modulation:**	**9**
Frequency modulation, Narrowband FM, Wideband FM – Generation of FM: Indirect method – FM demodulation: Frequency discriminator – Non-linear effects in FM systems – Noise in FM receivers – Capture effect – Pre-emphasis and de-emphasis in FM		
Unit – III	**Pulse Modulation and Baseband Pulse Transmission:**	**9**
Sampling process – PAM – Quantization process –PCM – TDM – Delta modulation, Line coding: Unipolar NRZ, Polar NRZ, Unipolar RZ, Manchester – Matched filter as optimum receiver – Intersymbol interference – Eye pattern – Nyquist criterion for distortion less baseband binary transmission – Pulse shaping with raised cosine filter –Adaptive equalization : LMS algorithm (concept only)		
Unit – IV	**Pass band Digital Transmission and Spread Spectrum Communication:**	**9**
Introduction – Coherent Phase Shift Keying: BPSK, QPSK, OQPSK, π/4 shifted QPSK – QAM- BER analysis of BPSK and QPSK – Minimum Shift Keying – Spread spectrum: PN sequence and its properties- Direct sequence spread spectrum-Frequency hopping spread spectrum		
Unit – V	**Information Theory and Coding:**	**9**
Entropy and its properties – Source coding theorem : Huffman coding, LZ coding – Discrete memoryless channel – Mutual information and its properties – Channel coding theorem – information capacity theorem; Hamming codes – Convolutional codes – Trellis diagram– Viterbi algorithm		
		Total:45

TEXT BOOK:

1.	Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, New Delhi, 2017.

REFERENCES:

1.	GautamSahe, Taub& Schilling, "Principles of Communication Systems", 4th Edition, McGraw-Hill, 2019, New Delhi
2.	Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communications", 2nd Edition, John Wiley & Sons, 2012, New Delhi
3.	A.Bruce Carlson, “Communication Systems: An Introduction to Signals and Noise in Electrical Communication”, 5th Edition, McGraw Hill, 2010, New Delhi

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concept of amplitude modulation and infer the effect of noise in AM receivers	Applying (K3)
CO2	infer the concept of narrowband and wide band FM and interpret the effect of noise in FM receivers	Understanding (K2)
CO3	identify the notion of baseband pulse transmission, inter-symbol interference and its compensation methods	Applying (K3)
CO4	illustrate the scheme of passband digital transmission for bandlimited and wideband signals	Understanding (K2)
CO5	identify the characteristics of discrete memoryless channel and provide the solution for lossless, error free communication	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2					2	2	2		2	
CO2	3	2	2	2					2	2	2		2	
CO3	3	3	3	3	2		2	2	3	3			2	
CO4	3	3	2	2	2		3		3	3	2	2	2	
CO5	3	3	3	3	2		2	2	3	3		2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	55	35	-	-	-	100
CAT2	15	55	30	-	-	-	100
CAT3	10	55	35	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECC51 -EMBEDDED SYSTEMS AND IOT

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microprocessor and Microcontroller**	**5**	**PC**	**3**	**0**	**2**	**4**

Preamble	Interpret the concepts of microcontroller, display devices and sensors to make an automated embedded product.

Unit – I	**Introduction to 8 bit Microcontroller:**	**9**
Architecture of PIC 16F877A- Register file structure -CPU Register- Status Register- Instruction sets- Addressing modes -Simple programs using ALP- Oscillator and reset circuits-Program memory -Data memory.		
Unit – II	**On-Chip Peripherals:**	**9**
On-chip Peripherals: Timers-Compare-Capture and PWM Modules- Interrupts - Watchdog timer– ADC-USART - ALP for Timers		
Unit – III	**PIC Programming in C:**	**9**
Simple I/O port programming-LED-7 segment , Multiplexed 7 segment – switch-Timer programming – ADC-USART		
Unit – IV	**Case Studies on Boiler conveyer and clock:**	**9**
Automation in boilers - Temperature, Pressure, Water level-display in LCD-Automation in conveyor based LPG cylinder filling - cylinder count - weight - sealing-display in 7 segment- digital Alarm clock through I2C protocol.		
Unit – V	**Case Studies on Development of IoT Applications :**	**9**
Home automation using PIC microcontroller, GSM and ThingSpeak. Development of Weather monitoring system: air temperature, humidity and temperature-Upload and control with cloud application.		

List of Exercises / Experiments :

1.	Device ON / OFF using PIC 16F877A microcontroller (Relay and LED).
2.	Interfacing of 7-segment and switch with PIC 16F877A microcontroller.
3.	Interfacing of LCD with PIC 16F877A microcontroller.
4.	Analog sensor interfacing with PIC16F877A microcontroller.
5.	Simulation: PWM based speed control of DC motor using PIC16F877A microcontroller
6.	Hardware: PWM based speed control of DC motor using PIC16F877A microcontroller
7.	Design of clock using Real Time Clock with PIC 16F877A microcontroller.
8.	Design of Weather monitoring system.

Lecture:45, Practical:30, Total:75

TEXT BOOKS:

1.	Data Sheet: https://ww1.microchip.com/downloads/en/devicedoc/39582b.pdf.
2.	Peatman & John B, “Design with PIC Microcontrollers”, 1st Edition, Pearson Education, New Delhi, 2009.

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Proteus/CCS compiler

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	comprehend the architecture and concepts of PIC microcontroller	Applying (K3), Precision (S3
CO2	illustrate the working principle of internal peripherals in PIC microcontroller and its applications	Applying (K3), Precision (S3
CO3	apply embedded C programming skills for on-chip peripherals ,External input output devices in real applications using PIC microcontroller	Applying (K3), Precision (S3
CO4	develop embedded C program for automation process in boilers, conveyor based LPG cylinder filling and digital clock	Applying (K3), Precision (S3
CO5	Design and build hardware and software for IoT applications	Applying (K3), Precision (S3

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**				**2**							**1**		
CO2	**3**											**1**		
CO3	**3**		**2**	**1**	**3**							**2**	**3**	**2**
CO4	**3**	**1**	**2**	**2**	**3**	**1**		**2**	**3**		**2**	**3**	**3**	**2**
CO5	**3**	**2**	**2**	**3**	**3**				**3**		**2**	**3**	**3**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80	-	-	-	-	100
CAT2	10	50	40	-	-	-	100
CAT3	10	45	45	-	-	-	100
ESE	10	50	40	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECC52 - ANTENNAS AND WAVE PROPAGATION

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**2**	**0**	**2**	**3**

Preamble	To design and analyze the state of the art in antenna based on fundamental principle and understand its parameter measurements.

Unit – I | **Fundamentals of Antenna:** | **6**

Radiation from Hertzian- Power radiated and radiation resistance, Half-wave dipole– Power radiated and radiation resistance –– Definitions: Radiation pattern –Radiation intensity – Gain –Directive gain – Power gain –Directivity – Beam width – Bandwidth, Effective length and effective area – Relation between maximum aperture and gain –Folded dipole.

Unit – II | **Antenna Arrays:** | **6**

Types of Arrays–Linear array with n-isotropic point sources of equal amplitude and spacing– Broadside case, End-fire case - Method of pattern multiplication –Binomial array- Yagi Uda antenna - Log periodic dipole array, Concept of phased array antenna

Unit – III | **Special and Aperture Antennas:** | **6**

Helical antenna: Normal mode and axial mode of radiation - Horn antenna - Antenna with parabolic reflectors and feeding system - Microstrip patch antenna: Rectangular patch: transmission line model design procedure - Smart antennas

Unit – IV | **Propagation of Radio Waves:** | **6**

Ground wave propagation - Tropospheric wave propagation- Line of sight distance- Effective earth's radius, Field strength of tropospheric wave - Sky wave propagation – Effective dielectric constant and conductivity of ionosphere-Virtual height- Critical frequency - Maximum usable frequency – Skip distance

Unit – V | **Antenna Measurements:** | **6**

Antenna impedance measurement– Radiation pattern measurements–Measurement of directivity, Measurement of antenna gain – Measurement of radiation resistance – Antenna efficiency – Polarization

LIST OF EXPERIMENTS / EXERCISES:

1.	Demonstrate and plot the radiation pattern of dipole antenna
2.	Demonstrate and plot the radiation pattern of Yagi-Uda antenna
3.	Demonstrate and plot the radiation pattern of Helical antenna
4.	Design and simulate a rectangular microstrip patch antenna
5.	Design and simulate a circular microstrip patch antenna
6.	Simulate a Phased array antenna and observe its radiation characteristics
7.	Observe the S-parameters of antenna using Vector Network analyzer
8.	Design and Simulate a Slot antenna
9.	Miniproject

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Prasad K.D, "Antennas and Wave Propagation", 4th Edition, Satya Prakashan Publications, New Delhi, 2019.

REFERENCES/ MANUAL /SOFTWARE:

1.	Kraus John D& Marhefka Ronald J& Ahmad S. Khan, "Antennas and Wave Propagation", 5th Edition, McGraw Hill, New Delhi, 2018.
2.	Balanis Constantine A, "Antenna Theory", 4th Edition, John Wiley & Sons, New York, 2016.
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the concept of antenna parameters and its terminologies using measurements	Understanding (K2), Manipulation (S2)
CO2	identify the performance of antenna array with its radiation pattern with measurement	Applying (K3), Manipulation (S2)
CO3	show the characteristics of special antennas with measurements and simulation tool	Applying (K3), Precision (S2)
CO4	describe the different types of wave propagation effects on the atmospheric layers	Understanding (K2), Precision (S2)
CO5	summarize the importance of antenna parameter measurements	Understanding (K2), Manipulation (S2)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			3				3					3
CO2	3	3	2	2	3				3	2			2	3
CO3	3	2	2	2	3				3	2		2	2	3
CO4	3	3					2			2				
CO5	3	2						2		2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	75	10	-	-	-	100
CAT2	15	65	20	-	-	-	100
CAT3	25	75	-	-	-	-	100
ESE	15	65	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECL51-VLSI DESIGN LABORATORY

Programme & Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Electronics	5	PC	0	0	2	1

Preamble	To design and implement digital circuits using Verilog Hardware Description Language

LIST OF EXPERIMENTS / EXERCISES:

1.	Modeling of combinational circuits and its verification using test bench
2.	Modeling of sequential digital systems and its verification using test bench
3.	Design and simulate vending machine controller using FSM
4.	Design and implementation of ALU in FPGA
5.	Design and implementation of 4X4 array multiplier and Wallace tree in FPGA
6.	Design and simulate Booth multiplier
7.	Design and simulate a 8 x 8 FIFO memory
8.	Design and Implement a real time clock using FPGA
9.	Design and simulation of basic gates using CMOS transistors
10.	Design and simulation of D-Flipflop using CMOS transistors
11.	Miniproject
	Total:30

REFERENCES/ MANUAL / SOFTWARE:

1.	Laboratory Manual
2.	ModelSim, Xilinx ISE and any SPICE Package

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	design and verify the functions of digital systems using Verilog	Applying (K3) , Precision (S3)
CO2	implement digital systems in FPGA	Applying (K3) , Precision (S3)
CO3	design digital circuits at transistor level	Applying (K3) , Precision (S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3				3			3	3	3
CO2	3	2	3	2	3				3			3	3	3
CO3	3	2	3	2	3				3			3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22ECL52- ANALOG AND DIGITAL COMMUNICATION LABORATORY							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Signal Processing, Electronic Circuits**	**5**	**PC**	**0**	**0**	**2**	**1**

Preamble	To build a firm foundation on analog and digital communication systems.

LISTOF EXPERIMENTS/EXERCISES:

1.	Verification of AM and FM using SDR
2.	Verification of analog pulse modulation using discrete components
3.	Verification of Pulse code modulation and demodulation
4.	Verification of Delta Modulation and demodulation
5.	Verification of Time division multiplexing and demultiplexing
6.	Simulation of line coding and verification of eye pattern
7.	Simulation of binary modulation(BASK,BFSK,BPSK)and observation through SDR
8.	Simulation of Minimum Shift Keying and Observation through SDR
9.	Simulation of M-ary modulation(QPSK, 16QAM)and implementation using SDR
10.	Generation of Huffman coding and decoding
11.	Simulation of Linear Block Codes

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	MATLAB
3.	SDR manuals

COURSEOUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	examine the analog modulation, analog to digital pulse conversion and transmission.	Analyzing (K4) , Precision(S3)
CO2	analyze the passband digital communication.	Analyzing (K4) , Precision(S3)
CO3	infer the performance of source coding and channel coding	Analyzing (K4) , Precision(S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3				2	3	2	2	2	
CO2	3	3	3	3	3				2	3	2	2	2	
CO3	3	3	3	3	3				2	3	2	3	2	

1–Slight, 2–Moderate, 3–Substantial, BT-Bloom's Taxonomy

22GEL51 - PROFESSIONAL SKILLS TRAINING – II							
(Common to All BE/ Btech Engineering and Technology branches)							
Programme & Branch	**All BE/ Btech Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**EC**	**0**	**0**	**80**	**2**

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit – I	**Soft Skills – II :**	**20**
Group discussions: Advantages of group discussions-Structured GD- Team work: Value of team work in organizations- Definition of a team, why team-Elements of leadership, disadvantages of a team, stages of team formation- Group development activities. Facing an interview: Foundation in core subject- industry orientation / knowledge about the company- professional personality-Communication skills-Activities before Interview, upon entering interview room, during the interview and at the end Mock interviews.		
Unit – II	**Quantitative Aptitude and Logical Reasoning – II:**	**30**
Problem solving level II: Money related problems-Mixtures-Symbol base problem-Clocks and calendars-Simple-linear-quadratic and polynomial equations-Special, equations-Inequalities-Sequence and series-Set theory-Permutations and combinations- Probability-Statistics-Data sufficiency- Geometry-Trigonometry-Heights and distances-Co-ordinate geometry-Mensuration. Logicalreasoning: Conditionality and grouping-Sequencing and scheduling- Selections-Networks:-Codes; Cubes-Venn diagram in logical reasoning-Quant based reasoning-Flaw detection- Puzzles-Cryptarithms.		
Unit – III	**Reading & Speaking Skills**	**30**
Reading: Reading comprehension– Effective Reading strategies – Descriptive, Inferential, & Argumentative reading passages – Identifying and locating factual information within a text – global reading/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.		
		Total:45

TEXT BOOK:

1.	Edgar Thorpe and Showick Thorpe, "Objective English for Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1.	Aruna Koneru, "Professional Speaking Skills," Oxford University Press India, New Delhi, 2015.
2.	Thorpe, Showick and Edgar Thorpe, "Winning at Interviews," 5th edition, Pearson Education, India, 2013.
3.	Rizvi, Ashraf M, "Effective Technical Communication," 2nd Edition, McGraw Hill Education India, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individualand as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply reading and speaking skills effectively for various academic and professional purposes	Applying (K3), Precision (S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						

* ±3% may be varied (CAT 1,2 & 3 – 50 marks)

22ECT61 - MICROWAVE AND OPTICAL COMMUNICATION							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transmission Lines and Waveguides, Electronic Circuits**	**6**	**PC**	**3**	**0**	**0**	**3**

Preamble	To understand the characteristics of passive microwave components, microwave semiconductor devices and the measurement of microwave signal parameters. To acquire the knowledge in optical fiber characteristics and the working of different optical sources and receivers for signal transmission.

Unit– I	**Microwave Networks and Circuit Representation:**	**9**
Microwave frequency-S parameter representation of N ports–Properties–Advantages- S Matrix of a directional coupler-Waveguide tees–Isolator–Circulator–Slotted section– Waveguide corners-Bends-Twists-Matched loads, Attenuator.		
Unit– II	**Microwave Semiconductor Devices and Vacuum Tubes:**	**9**
Gunn diode- Gunn effect- RWH theory–Avalanche transit time devices-Read diode– TRAPATT diodes-IMPATT diode-Reflex klystron: Velocity modulation-Power output-Efficiency and electronic admittance-Magnetron: Cylindrical magnetron.		
Unit– III	**Microstrip lines and Microwave Measurements:**	**9**
Microstrip lines–Losses in microstrip lines–Quality factor Q of microstrip lines – Measurements: Impedance–Frequency–Power –VSWR-Microstrip lines filters: LPF- Microwave radar equation		
Unit– IV	**Optical Fiber Structures and Digital Transmission Systems:**	**9**
Elements of an optical fiber transmission link- Total internal reflection – Acceptance angle – Numerical aperture–Optical fiber modes and configurations – Linearly polarized modes–Single mode fiber-Graded index fiber structure –Fiber fabrication.		
Unit– V	**Optic Sources and Optical Receivers:**	**9**
Direct and indirect band gap materials- LED structures: SLED, ELED – Concept of lasers diodes- Operation of PIN and APD diodes-Fundamental receiver operation – Error sources- Probability of error – Point to point link system considerations- Link power budget and rise time budget.		
		Total:45

TEXTBOOKS:

1. Samuel Y.Liao, “Microwave Devices & Circuits”, 3rd Edition, Pearson Education, New Delhi, 2015, for Units I,II,III.
2. Gerd Keiser, “Optical FiberCommunication”,5th Edition, McGraw Hill, New Delhi,2020, for Units IV,V.

REFERENCES:

1. Annapurna Das& Sisir K.Das,”MicrowaveEngineering”,3rd Edition, McGraw Hill Inc, New Delhi,2019.
2. JohnM. Senior, “Optical FiberCommunication”,3rd Edition, Pearson Education, New Delhi,2010.

COURSEOUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the features and characteristics of microwave components.	Understanding(K2)
CO2	summarize the principles of various microwave signal generators.	Understanding(K2)
CO3	describe the principles involved in microstrip lines and measure the microwave signal parameters.	Understanding(K2)
CO4	infer the different modes of wave propagation and configuration of optical fibre.	Understanding(K2)
CO5	describe the characteristics of various optical sources and receivers	Understanding(K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2										2	2	
CO2	3	2	2			2		2				2	2	
CO3	3	2	2		2	2					2		1	1
CO4	3	2											2	2
CO5	3	2						2				3		

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN – THEORY

Test/ Bloom's Category*	**Remembering(K1)%**	**Understanding (K2)%**	**Applying (K3)%**	**Analyzing (K4)%**	**Evaluating (K5)%**	**Creating (K6)%**	**Total %**
CAT1	25	75	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	25	75	-	-	-	-	100
ESE	20	80	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECT62 – DATA COMMUNICATION AND NETWORKING								
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Nil**	**6**	**PC**	**3**	**0**	**0**	**3**	

Preamble	To acquire adequate knowledge on the function of various internetworking devices, algorithms, protocols and its applications.	
Unit– I	**Network Architecture :**	**9**
OSI model – TCP/IP model – Guided media: Twisted pair, Coaxial and fiber optic cables Unguided media: Radio waves , Micro waves and infrared – Circuit switching networks – Datagram networks – Virtual circuit networks – Connecting devices : Hub, Bridge, Router, Gateway- Backbone networks.		
Unit– II	**Link Layer**	**9**
Error control-Cyclic codes-Simple protocol-Checksum-Stop and Wait-Go-Back-N: Send window- Receive window-Selective repeat–Point to Point protocol–Random Access: CSMA-Persistent methods-CSMA/CD-Minimum frame size-Energy level-CSMA/CA-IEEE802.3-Gigabit Ethernet-IEEE802.11-: Architecture-MAC Sub layer-Point coordination function- WLAN frame format.		
Unit– III	**Network Layer:**	**9**
IPV4: Address space – Classless addressing- Sub-netting- Address aggregation- Frame format-IPV6 Addressing and frame format-Address mapping: ARP and RARP–ICMPV4- Message format – Error reporting messages- Routing protocols: DVR: Bellman Ford Equation – Distance vector – LSR: Database – Dijkstra algorithm-RIP message- RIP algorithm – OSPF: Metric-Forwarding table-Areas-Link state advertisement –BGP: eBGP- iBGP.		
Unit– IV	**Transport Layer:**	**9**
UDP datagram, UDP services and applications-TCP services and features-Segment, TCP connection-Flow control-Congestion control – QOS-Definitions, Sensitivity of applications, Flow classes-Scheduling-Token bucket and leaky bucket.		
Unit– V	**Application Layer:**	**9**
E-Mail: Architecture, User agent, SMTP, POP3, IMAP4 and HTTP: Nonpersistent connections- Persistent connections- Message format-FTP: Control connection- Data connection – VoIP-Domain Name System (DNS): Name Space-Domain Name Space-Distribution of name space-zone-DNS in the internet.		
		Total:45

TEXTBOOK:

1.	Behrouz A. Forouzan, “Data communication and Networking”, 5th Edition, Tata McGraw Hill, New Delhi, 2019.

REFERENCES:

1.	James F. Kurose & Ross Keith W, “Computer Networking: A Top-Down Approach Featuring the Internet”, 6th Edition, Pearson Education, New Delhi, 2012.
2.	Tanen baum, Andrew S & David Wetherall,”Computer Networks”,5th Edition, PHI Learning, New Delhi, 2010.
3.	Kuhn, Nicolas, DavidRos, Amadou Baba Bagayoko, Chamil Kulatunga, Gorry Fairhurst, and Naeem Khademi.”Operating ranges, 172nalyzing172 and performance of CoDel and PIE. “Computer Communications103 (2017):74-82.

COURSEOUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	comprehend different network models and architecture.	Understanding (K2)
CO2	apply suitable flow, error and access control techniques for node-to node delivery.	Applying(K3)
CO3	analyze the routing mechanisms and IP address management.	Applying(K3)
CO4	apply suitable protocols for connection oriented and connectionless services in internet.	Applying(K3)
CO5	interpret the functionalities of application protocols.	Understanding(K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			2		2	2	2	2		2	2	
CO2	3	2		1			2	2		2		2	3	2
CO3	3	3	2	2	2		2	2	2	2		2	3	2
CO4	3	2	1	1	1			2		2		2	3	2
CO5	2	1			1			1					3	

1–Slight,2–Moderate,3–Substantial, BT- Bloom's Taxonomy

ASSESSMENTPATTERN – THEORY

Test/ Bloom's Category*	Remembering (K1)%	Understanding (K2)%	Applying (K3)%	Analyzing (K4)%	Evaluating (K5)%	Creating (K6)%	Total %
CAT1	20	60	20	-	-	-	100
CAT2	20	60	10	10	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	20	50	20	10	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECL61- MICROWAVE AND OPTICAL COMMUNICATION LABORATORY

Programme &Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	PC	0	0	2	1

Preamble	To measure and analyze the microwave and optical parameters

LISTOF EXPERIMENTS/EXERCISES:

1.	Demonstrate the mode characteristics of Reflex Klystron
2.	Observe the radiation characteristics of Horn antenna
3.	Verification of load impedance using VSWR
4.	Observe the VI characteristics and Power measurement of Gunn Diode oscillator
5.	Design and simulate the Magic Tee
6.	Design and simulate the microstrip LPF using transmission line step impedance method
7.	Measurement of numerical aperture and Digital signal transmission using fibre-optic
8.	Observe the VI&PI characteristics of LED and Laser diode
9.	Observe the VI&PI characteristics of APD/PD
10.	Observe the effective refractive index of the optical fiber using MATLAB

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	HFSS,ADS,MATLAB

COURSEOUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	measure the performance of microwave oscillators and its signal parameters using a microwave set-up.	Applying(K3) , Manipulation(S2)
CO2	interpret the characteristics of MagicTee and microstrip transmission lines, refractive index of optical fibre	Applying(K3), Precision(S3)
CO3	observe the characteristics of optical source, fibre and detector.	Applying(K3), Precision(S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3						3					
CO2	3	2	3		3				3		2	2	2	3
CO3	3	2	3		3				3		2	2	2	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom’s Taxonomy

22ECL62 – DATA COMMUNICATION AND NETWORKING LABORATORY							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**6**	**PC**	**0**	**0**	**2**	**1**

Preamble	To gain a hands-on experience in the field of computer networking such as creating different network topologies, network protocol implementation and 175nalyzing the performance using standard metrics

LISTOF EXPERIMENTS/EXERCISES:

1.	Simulation of various LAN topologies
2.	Realization of flow control algorithms
3.	Realization of ARP and Subnetting using IPV4 in campus area network.
4.	Analyze the functioning of Distance vector routing & Link state routing in intra domain routers.
5.	Analyze the network load performance using Leaky bucket algorithm
6.	Demonstrate data exchange using point to point: Server-Client Model
7.	Creation of three node for TCP traffic
8.	Analyzing TCP traffic with CSMA
9.	Simulation of 802.11 wireless LAN
10.	Packet capture and analysis using network protocol analyzer

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Netsim,NS-3,Wireshark

COURSEOUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply different network layer topologies.	Applying (K3), Manipulation (S2)
CO2	analyse L2, L3 and L4 protocols under different traffic conditions.	Analyzing (K4), Precision (S3)
CO3	analyse different data packets using packet capture tools.	Analyzing (K4), Manipulation (S2)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		1							1	
CO2	3	3	2	2	1	3			3	2		2	2	
CO3	3	3	2	2	1				3	2		2	2	

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

22ECP61 – PROJECT WORK I							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**6**	**EC**	**0**	**0**	**8**	**4**
							Total : 120

COURSEOUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify, analyze, interpret and formulate the real world problem and conceptualize the methodology of the project	Applying (K3)
CO2	design the electronics based system using mathematical analysis	Applying (K3)
CO3	develop the model using modern tools and demonstrate the working of the model	Analyzing (K4)
CO4	articulate the project report and presentations	Evaluating (K5)
CO5	plan and execute the project as a team	Evaluating (K5)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

22MNT31 – ENVIRONMENTAL SCIENCE								
(Common to All BE/Btech branches)								
Programme & Branch	**All B.E/B.Tech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3 / 6**	**MC**	**2**	**0**	**0**	**0**
Preamble	This course provides an approach to understand the various natural resources, ecosystem, bio-diversity, pollution control & monitoring methods for sustainable life and also to provide knowledge and to create awareness for engineering students on biological sciences.						
Unit – I	**Environmental Studies and Natural Resources**						**5**
Introduction to Environmental Science – uses, over-exploitation and conservation of forest, water, mineral, food, energy and land resources–case studies							
Unit – II	**Ecosystem and Biodiversity**						**5**
Ecosystems: concept and components of an ecosystem –structural and functional features – Functional attributes (Food chain and Food web only). Biodiversity: Introduction – Classification – Bio geographical classification of India- Values of biodiversity – Threats and Conservation of biodiversity – case studies.							
Unit – III	**Environmental Pollution**						**5**
Environmental Pollution: Definition – causes, effects and control measures of: (a) Air pollution – Climate change, global warming, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution – Role of an individual in prevention of pollution – case studies.							
Unit – IV	**Environmental Monitoring**						**5**
Sustainability –three pillars of sustainability- factors affecting environmental sustainability-approaches for sustainable development – Introduction to EIA – objectives of EIA – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act.							
Unit – V	**Introduction to Biological Science**						**5**
Functions of Carbohydrates, lipids, proteins and nucleic acids – Cells and its organelles – plasma membrane, mitochondria and nucleus- Heredity and DNA – organization of DNA in cells – Genes and chromosomes- Cell division –Types of cell division- mitosis & meiosis – Cell cycle and molecules that control cell cycle.							
							Total:25

TEXT BOOKS:

1.	Anubha Kaushik, and Kaushik C.P., “Environmental Science and Engineering”, 6th Multicolour Edition, New Age International Pvt. Ltd., New Delhi, 2018, for Unit-I, II, III, IV.
2.	Rastogi.SC, “Cells and Molecular Biology”, 2nd Edition, reprint, New Age International (P) Limited Publishers, New Delhi, 2008, for Unit-V.

REFERENCES:

1.	Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya V.N., “Environmental Science”, Pearson Education, New Delhi, Revised Edition 2019.
2.	Mukhtar Ahmad, “Text book of modern biochemistry”, Volume I & II, Oxford & IBH Publishing Co. Pvt. LTD, Delhi, 1995.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	illustrate the various natural resources and role of individual for its conservation	Understanding (K2)
CO2	elaborate the features of ecosystem and biodiversity to find the need for conservation.	Understanding (K2)
CO3	manipulate the sources, effects and control methods of various environmental pollution.	Applying (K3)
CO4	make use of the knowledge of EIA and environmental legislation laws towards sustainability.	Applying (K3)
CO5	explain the functions of carbohydrates, lipids, proteins, nucleic acids, Cells and its organelles	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1					3							
CO2	2	1					3							
CO3	3	2	1				3							
CO4	3	2	1				3							
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	NA						
ESE	NA						

* ±3% may be varied (CAT 1, 2 – 50 marks)

22GCT71 - ENGINEERING ECONOMICS AND MANAGEMENT

(Common to All BE/Btech branches)

Programme & Branch	**All BE/Btech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**HS**	**3**	**0**	**0**	**3**

Preamble	The aim of the course is to create fundamental knowledge on management by introducing concepts like economics, national income, marketing, operations management, accounting principles etc.	
Unit – I	**Micro Economics**	**9**
Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic Activities and Income.		
Unit – II	**Macro Economics, Business Ownership and Management concepts**	**9**
National Income and its Measurement Techniques. Inflation – Causes of Inflation – Controlling Inflation – Business Cycle – Forms of Business – Ownership Types. Management concepts: Taylor and Fayol's Principles – Functions of Management – Managerial Skills – Levels of Management – Roles of Manager.		
Unit – III	**Marketing Management**	**9**
Marketing – Core Concepts of Marketing – Four P's of Marketing – New Product Development – Intellectual Property Rights (IPR), Product Life Cycle – Pricing Strategies and Decisions.		
Unit – IV	**Operations Management**	**9**
Operations Management – Resources – Types of Production System – Site Selection, Plant Layout, Steps in Production Planning and Control – Inventory – EOQ Determination.		
Unit – V	**Financial Management**	**9**
Accounting Principles – Financial Statements and its Uses – Depreciation – Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting – Significance –Traditional and Discounted Cash Flow Methods.		
		Total:45

TEXT BOOK:

1.	Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1st Edition, McGraw Hill Education, Noida, 2013.

REFERENCES:

1.	Geetika, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics", 3rd Edition, McGraw-Hill, New Delhi, 2018.
2.	William J. Stevenson, "Operations Management", 14th Edition, McGraw-Hill Education, 2021.
3.	William G. Nickels, James M. McHugh, Susan M. McHugh, "Understanding Business", 12th Edition, McGraw-Hill Education, New York, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify market equilibrium and interpret national income calculations and inflation issues	Applying (K3)
CO2	choose a suitable business ownership for their enterprise and illustrate managerial functions	Applying (K3)
CO3	infer marketing management decisions	Understanding (K2)
CO4	apply appropriate operation management concept in business situations	Applying (K3)
CO5	interpret financial and accounting statements and evaluate new proposals	Applying (K3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2		
CO2		1	2			2	2	2	2	2	3	2		
CO3	1	2	1			2		2	2	2	3	2		
CO4	1	2	1			2		2	2	2	3	2		
CO5	2	2				2		2	2	2	3	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22ECP71 – PROJECT WORK II PHASE I

Programme & Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	EC	0	0	10	5
							Total : 150

COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify, analyze, interpret and formulate the real world problem and conceptualize the methodology of the project	Applying (K3)
CO2	design the electronics based system using mathematical analysis	Applying (K3)
CO3	develop the model using modern tools and demonstrate the working of the model	Analyzing (K4)
CO4	articulate the project report and presentations	Evaluating (K5)
CO5	plan and execute the project as a team	Evaluating (K5)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

22ECP81 – PROJECT WORK II PHASE II							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**8**	**EC**	**0**	**0**	**8**	**4**
							Total : 120

COURSEOUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify, analyze, interpret and formulate the real world problem and conceptualize the methodology of the project	Applying (K3)
CO2	design the electronics based system using mathematical analysis	Applying (K3)
CO3	develop the model using modern tools and demonstrate the working of the model	Analyzing (K4)
CO4	articulate the project report and presentations	Evaluating (K5)
CO5	plan and execute the project as a team	Evaluating (K5)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

22ECF01-MODERN ELECTRONIC INSTRUMENTATION							
Programme & Branch	**B.E – Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**2**	**0**	**2**	**3**

Preamble	To understand the principles of various instruments and transducers and to learn the importance of virtual instrumentation in system design.	
Unit – I	**Measurement Concepts And Measuring Instruments:**	**6**
Measurement systems- Static and dynamic characteristics – Units and standards of measurements – Error analysis –Digital meters: Wattmeter-Energy meters – wheatstone bridge.		
Unit – II	**Transducers:**	**6**
Strain gauge- Linear variable differential transformer- Capacitive transducer – Piezoelectric transducers – Vibration sensor– Proximity sensor-Implementation of Instrumentation amplifier with sensor.		
Unit – III	**Virtual Instrumentation & Software:**	**6**
Block diagram of a virtual instrument – Physical quantities and analog interfaces – Hardware and software – User interfaces – Advantages– LabVIEW – Graphical user interfaces – Controls and indicators.		
Unit – IV	**VI Software Tools & Programming Techniques:**	**6**
Editing, debugging and running a virtual instrument – Graphical programming palettes and tools – Front panel objects – Function and libraries– VI and sub-VI Decision structures – Formula nodes – Sequence structures – Arrays and clusters		
Unit – V	**PLC Programming:**	**6**
PLC: Evolution – Components of PLC – Advantages over relay logic – PLC programming languages – Ladder diagram – Programming timers and counters –PLC specifications – Timer functions: Types, Programming.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Programming exercises on Basic Arithmetic Operations.
2.	Programming exercises on Boolean Operations.
3.	Programming exercises for loops and charts
4.	Programming exercises for clusters and graphs.
5.	Programming exercises on string.
6.	Programming exercises on Shift Registers.
7.	Programming exercises on case and sequence structures, file input/output
8.	Programming exercises on Arrays.
9.	Creating Virtual Instrumentation for simple applications.
10.	Mini Project.

Lecture:30, Practical:30, Total:60

TEXT BOOKS:

1.	Helfrick Albert D. and Cooper William D, “Modern Electronic Instrumentation and Measurement Techniques”, 2nd Edition, PHI Learning, New Delhi, 2003, for Units I,II.
2.	Jeffery Travis and Jim Kring, “LabVIEW for Everyone: Graphical programming made easy and Fun, 3rd Edition, Pearson Education, India, 2009. for Units III,IV.
3.	Webb John W. and Reis Ronald A., “Programmable Logic Controllers”, 5th Edition, PHI Learning, New Delhi, 2005, for Unit V.

REFERENCES/ MANUAL / SOFTWARE:

1.	Jovitha Jerome, "Virtual Instrumentation using LabVIEW" , 1st Edition, PHI Learning, New Delhi, 2010.
2.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use different measuring instruments and sensors	Applying (K3), Precision(S3)
CO2	understand the working principle of various transducers for real time applications.	Understanding(K2), Precision(S3)
CO3	infer the basics of virtual instrumentation	Understanding(K2), Manipulation (S2)
CO4	develop programs and design virtual systems	Applying (K3), Precision(S3)
CO5	build ladder diagram for industrial applications.	Applying (K3), Precision(S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2										1	2	
CO2	2	1										2	3	
CO3	3	2			3				2	2		2	3	2
CO4	3	2		2	3				2	2		2	3	2
CO5	3	2		2	3				2	2		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30	-	-	-	100
CAT2	10	50	40	-	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	10	40	50	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE01 – MEDICAL ELECTRONICS

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the working of the various physiological systems in the human body and also to comprehend the basics of bio signals recording, various diagnostic , therapeutic devices and techniques	
Unit – I	**Human Physiology:**	**9**
Physiological systems of the Body – Basic medical instrumentation system and its performance requirements – General constraints in design of medical instrumentation systems –Origin of bioelectric signals –Propagation of action potentials- Bioelectric potentials : ECG,EEG and EMG		
Unit – II	**Basic Medical Recording System:**	**9**
Electrodes for ECG – Electrodes for EEG – Electrodes for EMG – Basic recording system –General consideration for electronic recorder amplifiers – Preamplifiers – Sources of noise in low level recording circuits – Digital stethoscope		
Unit – III	**Recording and Monitoring Instruments:**	**9**
Basic electrocardiograph machine – ECG leads – Phonocardiograph –Electroencephalograph – Electromyograph – Common artefacts in ECG and EMG – Measurement of heart rate- direct method of Blood pressure measurement – Carbon di-oxide method of respiration rate measurement –Single channel telemetry systems –Multichannel wireless telemetry system – Pulse Oximeter		
Unit – IV	**Measurements and Analysis Techniques:**	**9**
Basic principles of external cardiac pacemaker and ventricular synchronous demand pacemaker – Basic principles of a defibrillator- Electric shock hazards –Leakage currents – Test instruments for checking safety parameters of biomedical equipment- ECG arrhythmia monitoring system		
Unit – V	**Medical Instrumentation:**	**9**
Haemodialysis machine –Radio isotopes in medical diagnosis- Positron Emission Tomography (PET) scanner – Surgical diathermy machine- Electrodes used with surgical diathermy –Safety aspects in electrosurgical units – Artificial ventilation – Positive pressure ventilator.		
		Total:45

TEXT BOOK:

1.	Khandpur R. S, “Handbook of biomedical instrumentation”, 3rd Edition, McGraw Hill, New Delhi, 2014.

REFERENCES:

1.	Cromwell Leslie, Weibell Fred J & Pfeiffer Erich A, “Biomedical Instrumentation and Measurements”, 2nd Edition, Pearson Education, New Delhi, 2015.
2.	Reddy D.C., “Biomedical Signal Processing – Principles and Techniques”, 1st Edition, McGraw Hill, New Delhi, 2005

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	comprehend the physiological systems of the human body	Understanding (K2)
CO2	paraphrase the types of electrodes used in measurement of bio signals in recording system	Understanding (K2)
CO3	indicate the parameters of human system using the principles of recording and monitoring instruments	Understanding (K2)
CO4	describe the various measurement techniques and the need for electrical safety of biomedical devices	Understanding (K2)
CO5	explain the working principles of few medical instruments	Understanding (K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**				**1**						**2**	**3**	
CO2	**3**	**2**	**2**			**1**		**2**	**3**			**2**	**3**	
CO3	**3**	**2**	**2**			**1**		**2**	**3**			**2**	**3**	
CO4	**3**	**2**	**2**			**2**						**2**	**3**	
CO5	**3**	**2**				**1**						**2**	**3**	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	25	75	-	-	-	-	100
ESE	25	75	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

2ECE02 – COMPUTER ARCHITECTURE AND INTERFACING							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the fundamental structure of computer system and design of various functional units used to build the high performance processors and systems.	
Unit – I	**Structure of Computers and Machine Instructions:**	**9**
Functional units- Basic operational concepts – Bus structures – Software – Performance – Memory locations – Addresses and operations – Instruction and instruction sequencing – Addressing modes – Basic I/O operations – Stacks and queues.		
Unit – II	**Computer Arithmetic:**	**9**
Addition and subtraction of signed numbers – Design of fast adders – Multiplication of positive numbers- Signed Operand multiplication and Fast multiplication – Integer division – Floating point numbers and operations – IEEE standard for floating point numbers.		
Unit – III	**Basic Processing Unit:**	**9**
Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired Control – Semiconductor RAM-Static memories – asynchronous DRAM – synchronous DRAM-ROMs – Speed, size and cost.		
Unit – IV	**Virtual Memory and Input / Output Modules:**	**9**
Cache memories – Mapping functions- Virtual memory – Address translation-External devices – I/O modules – Programmed I/O – Interrupt-driven I/O – Direct Memory Access – I/O channels and processors.		
Unit – V	**Pipelining and Large Computer Systems:**	**9**
Data hazards and Instruction hazards(Concepts)-Superscalar operations-Forms of parallel processing-Array processors-Structure of general purpose multiprocessors-Memory organization in Multiprocessors-Program parallelism and shared variables.		
		Total:45

TEXT BOOK:

1.	Hamacher Carl, Vranesic Zvonko & Zaky Safwat, “Computer Organization”, 5th Edition, McGraw Hill, New Delhi, 2011.

REFERENCES:

1.	Stallings William, “Computer Organization and Architecture: Designing for Performance”, 10th Edition, Pearson Education, New Delhi, 2017.
2.	Hayes John P, “Computer Architecture and Organization”, 3rd Edition, McGraw-Hill, New Delhi, 2017

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the basic structure and operation of a digital computer	Understanding (K2)
CO2	design fast adder and fast multiplier for arithmetic operations for ALU	Applying (K3)
CO3	design memory sub-system for a typical computer	Applying (K3)
CO4	describe the various types I/O devices and memory organization	Understanding (K2)
CO5	infer about pipelining and large computer systems	Understanding (K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**												
CO2	**3**	**3**	**3**	**3**	**2**								**3**	**3**
CO3	**3**	**3**	**3**	**3**									**3**	**3**
CO4	**3**	**2**	**2**	**3**								**2**	**2**	
CO5	**3**	**2**	**3**	**3**								**2**	**2**	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	55	20	-	-	-	100
CAT2	25	55	20	-	-	-	100
CAT3	30	70	-	-	-	-	100
ESE	25	55	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE03 – EMBEDDED SYSTEM DESIGN							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microprocessor and Microcontroller**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the concept of embedded system life cycle including partitioning, toolset, emulators and testing.

Unit – I	**Embedded Design Life Cycle**	**9**
Embedded design life cycle – Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing selection processes: Performance tools – Benchmark – RTOS availability – Tool chain availability – Other issues in selection processes.		
Unit – II	**Partitioning Decision**	**9**
Hardware / Software duality – Coding hardware – ASIC revolution: Managing the risk, Co-verification – Execution environment: Memory organization –System start-up – Hardware manipulation: Memory mapped access, Speed and code density.		
Unit – III	**Embedded Toolset**	**9**
Interrupt service routines – Watch dog timers – Flash memory – Basic toolset : Host based debugging – Remote debugging – ROM emulators – Logic analyzer and caches – BDM – JTAG		
Unit – IV	**In circuit Emulators and Testing**	**9**
Bullet proof run control – Real time trace – Hardware break points – Testing: Bug tracking - Reduction of risks and costs – Performance - Types of testing		
Unit – V	**Analysis and Feasibility**	**9**
Power analysis – DC analysis –AC analysis – Thermal analysis – Signal integrity – MIBF – Reliability analysis – BOM compliance analysis – Structural – PI – EMI/EMC.		
		Total:45

TEXT BOOKS:

1.	Arnold S.Berger, “Embedded Systems Design: An Introduction to Processes, Tools, and Techniques Hardcover”, 1st Edition, CRC press, USA, 2017, for Units I, II, III, IV.
2.	Vilas S Bagad, ”Electronics Product design” Technical Publication, 3rd Edition,2020, for Unit V.

REFERENCES:

1.	Sri ram Iyer, “Embedded Real time System Programming”, 1st Edition, McGraw-Hill, 2008.
2.	David E.Simon, “An Embedded Software Primer”,12th Indian Reprint, Pearson Education, 2005.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	comprehend the design flow of an embedded system	Understanding(K2)
CO2	understand the software hardware duality of embedded system design and memory organization	Understanding(K2)
CO3	use various tools for hardware- software debugging	Applying (K3)
CO4	infer software debugging using emulator for embedded product and understand the different types of testing in embedded system	Understanding(K2)
CO5	understand and interpret the feasibilities in embedded software design	Understanding(K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**												**2**	
CO2	**3**	**2**											**2**	
CO3	**3**	**2**	**3**	**2**	**3**		**2**	**2**					**2**	**2**
CO4	**3**	**2**	**2**	**3**	**2**	**2**				**2**			**2**	**2**
CO5	**3**	**2**		**2**						**2**		**3**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80	-	-	-	-	100
CAT2	20	60	20	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	10	70	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF02 – DIGITAL IMAGE PROCESSING AND ITS APPLICATIONS								
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**2**	**0**	**2**	**3**

Preamble	To learn and apply the various Digital Image Processing techniques on real time images	
Unit – I	**Digital Image Fundamentals:**	**6**
Elements of digital image processing systems – Elements of visual perception– Brightness– Contrast– Hue– Saturation– Mach band effect – Image sampling– Quantization – Basic relationship between pixels - Color image fundamentals – RGB– HSI models- Need for transforms, DFT, DCT, and Haar transformation		
Unit – II	**Image Enhancement:**	**6**
Image enhancement: Basic intensity transformations, Piecewise linear transformation functions, Histogram equalization, Spatial and frequency domain filtering: Smoothing and sharpening filters.		
Unit – III	**Image Restoration:**	**6**
Image restoration: Degradation model – Noise distributions– Median – Geometric mean – Harmonic mean – Contra harmonic mean filters – Order statistics filters – Inverse and wiener filtering – Constrained least square filtering.		
Unit – IV	**Image Segmentation, Representation and Description:**	**6**
Point, line and edge detection – Basics of intensity thresholding – Region based segmentation : Region growing – Region splitting and merging, Image representation : Chain codes, – Boundary descriptors – Regional descriptors, Morphology – dilation and erosion – Opening and closing		
Unit – V	**Image Compression:**	**6**
Fundamentals: Types of redundancy – Huffmann – Run length coding – Arithmetic coding – Bit–plane coding – Block transform coding – Lossless and lossy predictive coding		

LIST OF EXPERIMENTS / EXERCISES:

1.	Study of Image Processing tool box – MATLAB
2.	Extraction of R,G,B componenets using color image and image conversion
Simulation of the following Image Processing techniques:	
3.	DCT and DFT on an input image
4.	Image enhancement using basic intensity transformation /histogram equalization/Bit plane extraction
5.	Image Smoothening Filters(Mean and Median filtering of an Image and Edge detection by sharpening filters
6.	Restoration of an original image by the addition of noise (Gaussian & Impulse)
7.	Morphological operation on an input image
8.	Miniproject

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Rafael C Gonzalez & Richard E Woods, “Digital Image Processing”, 4th Edition, Pearson Education, New Delhi, 2020

REFERENCES/ MANUAL / SOFTWARE:

1.	Jayaraman S, Esakkirajan S & Veerakumar T, “Digital Image Processing”, 1st Edition, 22nd Reprint, Tata McGraw Hill, New Delhi, 2018.
2.	Alan C. Bovik, “The Essential Guide to Image Processing”, 1st Edition, Academic Press, 2009
3.	Anil K Jain, “Fundamentals of Digital Image Processing”, 4th Edition, PHI Learning, New Delhi, 1995.
4.	Laboratory Manual
5.	MATLAB

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the fundamental concepts and image transforms	Applying (K3) , Precision (S3)
CO2	apply Image enhancement in both spatial and frequency domain to improve the quality of images	Applying (K3) , Precision (S3)
CO3	apply Image restoration techniques to restore the original image from noisy image	Applying (K3) , Precision (S3)
CO4	extract the features and region of interest of an image using segmentation, representation and description techniques for image classification	Applying (K3) , Precision (S3)
CO5	use image compression algorithms on digital images	Applying (K3) , Precision (S3)

Mapping of COs with POs and PSOs

COs,POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		3			2	2	2		2	2	
CO2	3	2	2	2	3	2		2	2	2		2	2	
CO3	3	2	2	2	3	2		2	2	2		2	2	
CO4	3	2	2	2	3	2		2	2	2		2	2	
CO5	3	2	2						2	2		2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30	-	-	-	100
CAT2	10	60	30	-	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	15	55	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF03 - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transforms and Probability Theory**	**5**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course provides an insight towards data handling and predictive modelling	
Unit – I	**Artificial Intelligence:**	**6**
Need to study AI - Applications of AI, Branches of AI, - defining intelligence using Turing test - Building an Intelligent agent		
Unit – II	**Preprocessing data:**	**6**
Installing package - Loading data – binarization - Mean removal – scaling – Normalisation - Label encoding		
Unit – III	**Supervised and Unsupervised Learning:**	**6**
Linear Regression - Logistic Regression classifier - Naïve Bayes classifier - Support Vector Machine - K-means clustering		
Unit – IV	**Probabilistic Reasoning for Sequential Data:**	**6**
Handling, slicing - Operating on time series data - Extracting statistics from time-series data - Generating data using HMM – Speech recognizer		
Unit – V	**Artificial Neural Network:**	**6**
Building a perceptron – Constructing single layered and multilayer neural networks – Architecture of Convolutional Neural Network - Types of layers in a CNN		

LIST OF EXPERIMENTS / EXERCISES:

1.	Build a single variable regressor
2.	Build a multivariable regressor
3.	Build a perceptron-based linear regressor
4.	Estimate housing prices using a Support Vector Regressor
5.	Stock market analysis using HMM
6.	Build an image classifier using a single layer neural network
7.	Build an image classifier using a convolutional neural network
8.	Miniproject

Lecture:30, Practical:30 Total:60

TEXT BOOK:

1.	Joshi, P.. “Artificial Intelligence with Python”, First Edition, United Kingdom: Packt Publishing, 2017

REFERENCES/ MANUAL / SOFTWARE:

1.	Courville, A., Goodfellow, I., Bengio, Y. ,“Deep Learning” , First Edition, United Kingdom: MIT Press., 2016
2.	Raschka, S. ,“Python Machine Learning” , First Edition, United Kingdom: Packt Publishing.,2015
3.	Robert S. Witte, John S. Witte. “Statistics” , First Edition, United States: John Wiley & Sons, Incorporated.,2016
4.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	comprehend about the intelligent agent	Understanding (K2) , Imitation (S1)
CO2	handle missing and outlier kinds of data	Applying(K3) , Manipulation(S2)
CO3	develop and test different regression and classification models	Applying(K3, Manipulation(S2)
CO4	determine the analysis of time series data	Applying(K3) , Precision(S3)
CO5	build and test deep learning models	Applying(K3) , Precision(S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2						2	2	
CO2	3	2	2	1	2	2						2	2	
CO3	3	2	2	2	2	2			2	2		2	3	
CO4	3	2	2	2	2	2			2	2		2	2	
CO5	3	2	2	2	2	2			2	2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	50	40	-	-	-	100
CAT2	10	40	50	-	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	20	45	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF04 – LINUX OPERATING SYSTEM							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course provides the foundations for understanding of the open source platform	
Unit – I	**Introduction:**	**6**
Linux History – Distributions – Installing Linux – First step on command line – Man pages- Working with directories- Working with files- Working with file contents – Linux file tree		
Unit – II	**Shell Expansion:**	**6**
Commands and arguments – Control operators – Shell Variables – Shell embedding and options – File globbing.		
Unit – III	**Pipes and commands:**	**6**
I/O redirection : Stdin, stdout, stderr, input redirection, output redirection – filters with examples – Basic Unix tools – Regular expressions –Bash history		
Unit – IV	**Vi Editor and Scripting :**	**6**
Introduction to vi – Scripting: Introduction – Scripting loops – Scripting parameters – more scripting.		
Unit – V	**User Management & File Security :**	**6**
User management – User passwords – User Profiles- standard file permission- access control lists-file links		

LIST OF EXPERIMENTS / EXERCISES:	
1.	Illustrate the working of file directories, files and file contents
2.	Write a shell program with control operators
3.	Display the shell variables illustrating all parameters
4.	Manipulate files with file globbing methods
5.	Create a file as needed and apply all the filters and use all the basic Unix Tools
6.	Write a script in Vi Editor illustrating the conditional and looping statements
7.	Display the list of users logged on and create a user in home directory and bash shell
8.	Demonstrate password management and file security features

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1. Paul Cobbaut, “Linux Fundamentals”, GNU Free Documentation License 2015.

REFERENCES/ MANUAL / SOFTWARE:

1. https://www.linux.org/docs/
2. https://www.raspberrypi.com/documentation/computers/using_linux.html
3. Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	realize different Linux distributions and Linux file tree	Understanding(K2) Precision(S3)
CO2	use Linux commands and apply shell operators	Applying(K3) Precision(S3)
CO3	interpret pipe commands and regular expressions	Applying(K3) Precision(S3)
CO4	apply scripting and looping methods in Vi Editor	Applying(K3) Precision(S3)
CO5	demonstrate the various file security operations and user management	Applying(K3) Precision(S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2								2	
CO2	3	2	2		2								2	
CO3	3	2	2		2								2	
CO4	3	2	2		2								2	
CO5	3	2	2		2								2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	60	25	-			100
CAT2	10	40	50	-			100
CAT3	10	40	50	-			100
ESE	10	40	50	-			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE04 – DATA SCIENCE FOR ENGINEERS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To acquire the basic concepts of data science to analyse large amounts of data using machine learning approaches and store the processed data in distributed environment.	
Unit – I	**Introduction to data science**	**9**
Benefits of data science – Facets of data – Data science process –Big data ecosystem and data science–Example using Hadoop. The data science process: Overview – Defining research goals – Retrieving data – Data Preparation – Exploratory data analysis — Building models — Building applications		
Unit – II	**Machine learning and handling big data**	**9**
Machine Learning in data science – Applications of machine learning in data science process – The modelling process, Types of ML.handling Large Data: Problems in handling large data – General techniques – Programming tips – Case Study: Predicting malicious URLs.		
Unit – III	**Distributed data storage and processing**	**9**
Distributing data storage and processing with frameworks: Hadoop – Spark – Case study: Assessing risk with loaning money.		
Unit – IV	**NoSQL and graph database**	**9**
Introduction to NOSQL: ACID– CAP Theorem – The BASE Principles of NoSQL Databases – NoSQL database types – Case Study: Disease prediction– Graph Database: Introducing connected data and graph databases – Connected data example.		
Unit – V	**Text Mining and Text Analytics**	**9**
Test mining in real world – Text mining techniques: Bag of words – Stemming and lemmatization – Decision tree classifier –Case Study: Classifying Reddit posts.		
		Total:45

TEXT BOOK:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, “Introducing Data Science – Big Data, Machine Learning and more,Using Python Tools”, 1st Edition, Manning Publications, 2016.

REFERENCES:

1. http://education.EMC.com/academicalliance, “Data Science and Big data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, 1st Edition, EMC Education Services, 2015
2. Joel Grus, “Data Science from the Scratch”, 2nd Edition, O"Reilly Publications, 2019

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understanding the flow of data Science Process	Understanding (K2)
CO2	apply machine learning methods to solve problems with large data	Applying (K3)
CO3	experiment with Hadoop and Spark platform for data science applications	Applying (K3)
CO4	apply the data science process to solve real world problems using NoSQL database and Graph database	Applying(K3)
CO5	make use of text analytics techniques for building solutions for text mining problem	Applying(K3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2		
CO2	3	2	2	2	3						2	2	2	2
CO3	3	2	2	2	3						2	2	2	2
CO4	3	2	2	2	3						2	2	2	2
CO5	3	2	2	2	3						2	2	2	2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	60	25	-	-	-	100
CAT2	10	40	50	-	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	10	40	50	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE05-MOBILE COMMUNICATION							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Analog & Digital communication**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	To acquire the fundamental concepts in cellular communication technology and articulate the study of 5G mobile technologies.	
Unit– I	**Cellular Concept**	**9**
Frequency reuse–Channel assignment strategies – Handoff strategies – Interference and system capacity – Co-channel interference and system capacity- Improving coverage and capacity		
Unit– II	**Propagation models and Channel Models**	**9**
Large scale propagation: Free space propagation model- Terrestrial propagation: Reflection- Two ray ground model – Outdoor propagation model — Durkin model – Small-scale multipath propagation and measurements – Mobile multipath channel parameters –Types of small-scale fading- Rayleigh and Rician channel models.		
Unit– III	**Equalizers and Diversity Techniques**	**9**
Introduction to equalization – A generic adaptive equalizer – Linear equalizers, Nonlinear equalizers- Equalizer algorithms—Zero forcing-Least mean square-Selection diversity – Maximum ratio diversity-RAKE receiver		
Unit– IV	**Multiple Access Techniques for Wireless Communications**	**9**
FDMA-TDMA-Spread spectrum multiple access-Capacity of cellular CDMA – SDMA – WCDMA-Packet radio protocols-Capture effect in packet radio		
Unit– V	**Advanced Wireless Communication**	**9**
System architecture evolution – Architecture of LTE : High level architecture, User equipment, Evolved UMTS Terrestrial radio access network, Evolved packet core, Roaming architecture–OFDMA in a Mobile cellular network : Multiple access, Fractional frequency Re-use, Channel estimation–SCFDMA,5G communication –Application		
		Total:45

TEXTBOOK:

1.	Rappaport S.Theodore, “Wireless Communications”,2nd Edition, Pearson Education, 2010, for Units I,II,III,IV.
2.	Christopher Cox., “An Introduction to LTE:LTE, LTE Advanced, SAE, VoLTE and 4G Mobile Communications”, 2nd Edition, Wiley Publications, NewDelhi,2014, for Unit V.

REFERENCES:

1.	Erik Dahlman, Stefan Parkvall, Johan Skold ,” The Next Generation Wireless Access Technology 5G NR: The 5G NR”,2018
2.	Saad Z. Asif. 5G Mobile Communications Concepts and Technologies, 1st Edition, CRC Press Taylor & Francis Group, USA, 2019.

COURSEOUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	describe the cellular concept and its coverage with capacity improvement techniques.	Understanding (K2)
CO2	identify the propagation models and channel models	Understanding (K2)
CO3	interpret the effects of multipath propagation and the compensation by diversity and equalization	Applying (K3)
CO4	elaborate the concepts of multiple access techniques for real world problems	Understanding (K2)
CO5	Summarize the characteristics of 4G wireless networks, architecture and multiple access	Understanding (K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2											
CO2	3	2	2	2	3									
CO3	2		3		3								2	
CO4	3	2			2									
CO5	3											2	2	

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN –THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	30	70		-	-	-	100
CAT2	10	60	30	-	-	-	100
CAT3	30	70		-	-	-	100
ESE	20	60	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE06 – EMBEDDED ARCHITECTURE AND STANDARDS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microprocessor and Microcontroller**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	Interpret the concepts of hardware, software &PCB architectures and manufacturing procedures for embedded product.	
Unit – I	**HARDWARE ARCHITECTURE:**	**9**
Understanding of embedded system- Product specifications with examples – Component selection – Component package types-Embedded system design flow types- Preparation of block diagram to final product architecture arrival		
Unit – II	**SOFTWARE ARCHITECTURE:**	**9**
System software–Embedded system software layered architecture-Understanding of different Operating System (Linux, Windows, VxWorks, and RTOS) features and architectures – Basics of boot loader functionalities–Significance of kernel and device drivers – File system types.		
Unit – III	**PCB ARCHITECTURE:**	**9**
Understanding of PCB design principles – Different PCB options – PCB component placement guidelines – PCB layout routing – Gerber generation		
Unit – IV	**DESIGN FOR MANUFACTURING:**	**9**
Understanding of basic component assembly process – Different ways of assembly – Machine assembly/manual assembly – Component storage options – Assembly flow understanding of basic mechanical ID design – Different mechanical enclosure options – Advantages & disadvantages of different mechanical enclosure		
Unit – V	**CERTIFICATION OF STANDARDS:**	**9**
Different certifications – Types of certifications for embedded system product features of FCC/CE and UL standards – DO254 standards and its components- DO178 standards and its components		
		Total:45

TEXT BOOK:

1.	Vilas S Bagad, “Electronics product design”, Technical publications, 3rd Edition,2020.

REFERENCES:

1.	Rajkamal, “Embedded system- Architecture, programming and design”, 3rd edition, Mcgraw Hill, 2017.
2.	Vilas S Bagad, ”Electronics Product design” Technical Publication, 3rd Edition,2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the hardware architecture of embedded product	Understanding (K2)
CO2	understand the software layered architecture of embedded product	Understanding (K2)
CO3	describe the printed circuit board design principles	Understanding (K2)
CO4	understand the concept of final product assembly sequence	Understanding (K2)
CO5	distinguish different certification standards	Understanding (K2)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3										2		2	2
CO2	3	2			2						2		2	2
CO3	3	2	2		2		3				2		2	2
CO4	3	2	3	2		3	3	3			3	3	3	3
CO5	3		3			3	3	3					3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	20	80	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF05- ELECTRONICS CIRCUIT BOARD DESIGN							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To understand the different types of Printed Circuit Boards, apply design considerations, steps to fabricate PCB, different tools for PCB design and component tracing in assembled PCBs.	
Unit – I	**Introduction to PCB designing concepts:**	**6**
Types of components used in PCB – Types of PCBs – Single layer – Double layer and multi-layer PCB – Flexible PCB – PCB manufacturing basics		
Unit – II	**PCB Design Considerations:**	**6**
General, mechanical and electrical considerations – Design rules for analog, digital and high frequency circuits – Electromagnetic interference/ Compatibility (EMI/ EMC).		
Unit – III	**Design and Simulation of PCB:**	**6**
Electronic Design Automation (EDA) Tools – Single layer PCB – Two layer PCB – Circuit design and simulation – Creating footprint, Placement and routing- Generating Gerber file for single layer PCB.		
Unit – IV	**PCB Fabrication Techniques:**	**6**
Image transfer techniques – Plating techniques: Immersion, Electro less, Electroplating – Solder Mask –Etching techniques – Mechanical operations.		
Unit – V	**Circuit Tracing and Testing & Case studies:**	**6**
Soldering techniques – Testing PCB – Environmental concern – Case studies: Power supply, Wien-bridge Oscillator.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Design of single layer circuit board using discrete components.
2.	Soldering and de-soldering the components on the PCB including SMD devices
3.	Design and Simulation of 230V AC to 5V/9V/12V DC Power Supply
4.	Design and implementation of IR Sensor Module.
5.	Preparation of layout from the circuit design
6.	Trouble shooting of single layer PCB
7.	Trouble shooting of multi-layer PCB
8.	MiniProject

Lecture:30, Practical:30, Total:60

TEXT BOOKS:

1.	Khandpur R.S., “Printed Circuit Board: Design, Fabrication, Assembly and Testing”, 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2017 for Unit I, II, IV, V
2.	Laboratory Manual for Unit III

REFERENCES/ MANUAL / SOFTWARE:

1.	Mehta S.D, “Electronic Product Design”, 1st Edition, S Chand Publications, New Delhi, 2011.
2.	Clyde Coombs, “Printed Circuits Handbook”, 6th Edition, McGraw Hill Professional, New Delhi, 2007.
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize different types of PCBs	Understanding (K2)
CO2	outline the PCB design rules and considerations	Understanding (K2)
CO3	apply the PCB Design rules to construct, simulate and verify the working of a single layer PCB	Applying (K3) , Precision (S3)
CO4	develop Gerber file for fabrication of a single layer PCB for any given circuit	Applying (K3) , Precision (S3)
CO5	identity the, faults and suggest solutions to rectify the faults in single layer PCBs	Applying (K3), Precision (S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	2
CO2	3	2											2	2
CO3	3	2	3		3				2	2		2	2	2
CO4	3	2	3	2	3			2	2	2		2	2	2
CO5	3	3	3	2	3	2	2	2	2	2		2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT2	30	50	20	-	-	-	100
CAT3	20	50	30	-	-	-	100
ESE	20	50	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF06 – SINGLE BOARD COMPUTER							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To apply basic knowledge of single board computer for multifunctional tasks like IoT, Image analysis for research applications.	
Unit – I	**Introduction to SBC and Linux Basics:**	**6**
Types of single board computer – Raspberry pi setup and management – Networking – Raspbian OS – Terminal access – Text editor- Accessing files.		
Unit – II	**Python Programming and Sensor Interfacing:**	**6**
Python programming: GPIO pin out and access – LED & Switch – Timers – Digital sensor interfacing – External circuit interfacing – UART – GPS interfacing.		
Unit – III	**Peripheral Control:**	**6**
Relay interfacing – DC motor control using PWM – Stepper motor interfacing – External analog to digital converter – Interfacing touch screen.		
Unit – IV	**Internet of Things:**	**6**
Introduction to Internet of Things – Display sensor readings on webpage – Sending sensor data to Thingspeak – Sending Email – Responding to tweets using dweet and IFTTT - Control peripheral device : Smart switches		
Unit – V	**Image Processing in SBC:**	**6**
Introduction to OPENCV – Reading and writing images : Create image – Conversion – Capturing camera frames – Image processing in SBC: Edge detection		

LIST OF EXPERIMENTS / EXERCISES:

1.	Develop a of bootable OS and Initialize the setup for Raspberry Pi
2.	Interfacing of GPIO for I/O devices in Raspberry Pi
3.	Interfacing of digital sensors with Raspberry Pi
4.	Interfacing DC Motor Control using PWM with Raspberry Pi
5.	Develop an IoT based device using SBC
6.	Interfacing a camera with SBC
7.	Build a burglar detector with photo capture using SBC
8.	Miniproject

Lecture:30, Practical:30, Total:60

TEXT BOOKS:

1.	Simon Monk, “Raspberry Pi Cookbook: Software and Hardware Problems and Solutions”, 3rd Edition, O’Reilly Media Inc, California, USA, 2020, for Units I, II,III,IV.
2.	Joe Minichino, Joseph Howse, “Learning OpenCV 4 Computer Vision with Python 3 –Get to grips with tools, techniques, and algorithms for computer vision and machine learning”, 3rd Edition, Packt Publishing Ltd.,2020, ISBN, for Unit V

REFERENCES/ MANUAL / SOFTWARE:

1.	Guillermo Guillen, “Sensor Projects with Raspberry Pi: Internet of Things and Digital Image Processing”, A Press Media,1st Edition 2019.
2.	https://www.raspberrypi.com/documentation
3.	https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html
4.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the fundamentals of an SBC for development of embedded applications	Understand (K2), Precision (S3)
CO2	build program to access ports and interface peripherals	Applying (K3) , Precision (S3)
CO3	develop embedded applications using a single board computer	Applying (K3) , Precision (S3)
CO4	apply the concepts of internet of things in an SBC	Applying (K3) , Precision (S3)
CO5	apply computer vision and image processing using SBC	Applying (K3) , Precision (S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				2									
CO2	2	2	2		3								3	
CO3	2	2	2		3								3	
CO4	2	2	2	2	3	2			3	2	2	3	3	2
CO5	2	2	2	2	3	2			3	2	2	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	10	20	70	-	-	-	100
CAT3	10	20	70	-	-	-	100
ESE	10	20	70	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF07 - ASIC DESIGN

Programme& Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**VLSI Design**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To understand the architecture of programmable ASICs and to perform logic synthesis and physical design flow in ASIC design	
Unit – I	**Introduction to ASICs and Programming Technologies:**	**6**
Types of ASICs – Design flow – Transistor parasitic capacitance – Logical effort-Antifuse – Static RAM – EPROM and EEPROM technology.		
Unit – II	**Programmable ASICs, logic cells and I/O Cells:**	**6**
Actel ACT – Xilinx LCA – DC & AC inputs and outputs – Clock & power inputs.		
Unit – III	**Programmable Interconnects and Logic Synthesis:**	**6**
Actel ACT – Xilinx LCA – Verilog logic synthesis: Delays, blocking and nonblocking assignment, combinational logic, multiplexers, case statement, decoders, arithmetic and sequential logic.		
Unit – IV	**Partitioning, Floorplanning and Placement**:	**6**
Physical design flow –System partitioning – FPGA partitioning: KL algorithm –Floorplanning –Placement : placement algorithms		
Unit – V	**Routing:**	**6**
Global routing – Detailed routing –Area routing-Maze algorithm-Channel routing- Left edge algorithm-Special routing.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Design, simulation and synthesis of Adders
2.	Design, simulation and synthesis of multipliers
3.	Design, simulation and synthesis of counters
4.	Design, simulation and synthesis of memory

For the following circuits,
a) Perform the functional verification
b) Synthesis the design
c) Generate the layout (Automatic)
d) Tabulate the area, power, delay

5.	Arithmetic and Logic Unit
6.	Finite State Machine
7.	Vending Machine
8.	MiniProject

Lecture:30, Practical:30, Total:60

TEXT BOOKS:

1.	Smith M.J.S, “Application Specific Integrated Circuits”, 12th Edition, Pearson Education Pvt. Ltd, New Delhi, 2013, for Units I,II, and III.
2.	Gerez, S.H, “Algorithms for VLSI Design Automation” John Wiley & Sons, Newyork, Reprint 2008, for Unit IV,V.

REFERENCES/MANUAL/SOFTWARE :

1.	Wayne Wolf, “FPGA-Based System Design”, 1st Edition, PHI, New Delhi, 2009.
2.	Erik 207arson, “Introduction to Advanced System-on-Chip Test Design and Optimization”, 1st Edition, Springer, USA, 2005.
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate the types of ASICs and programming technologies	Understanding (K2), Manipulation(S2)
CO2	elucidate the programmable ASIC logic cells and I/O cells	Understanding (K2), Manipulation(S2)
CO3	infer the programmable interconnects and synthesis	Understanding (K2), Manipulation(S2)
CO4	apply algorithms for partitioning, floor planning and placement	Applying (K3), Manipulation(S2)
CO5	construct routing design in an ASIC	Applying (K3), Manipulation(S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3										3	3	3
CO2	3	3										3	3	3
CO3	3	3	3		3				3	3		3	3	3
CO4	3	3	3		3				3	3		3	3	3
CO5	3	3	3		3				3	3		3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	90	-	-	-	-	100
CAT2	10	90	-	-	-	-	100
CAT3	10	20	70	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF08– SOFT COMPUTING TECHNIQUES							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To learn and apply the neural network algorithms and fuzzy logic to solve real world problems.	
Unit - I	**Introduction To Neural Networks:**	**6**
Introduction, Humans and computers - Organization of the brain, Biological neuron - Characteristics of ANN - Types of neuron activation function - Terminologies of ANN - Learning strategy (Supervised, Unsupervised, Reinforcement) - McCulloch-Pitts model – Hebb rule		
Unit - II	**Learning Networks:**	**6**
Supervised learning networks: Perceptron network: Theory – Architecture- Learning rule, Back propagation network : Theory – Architecture- Training and testing algorithm - Radial Basis Function Network (RBFN) – Unsupervised learning networks : - Kohonen self organising feature maps.		
Unit - III	**Genetic Algorithm :**	**6**
Introduction – Basic terminologies – Operators in GA : Encoding, Selection, Crossover, Mutation, Stopping criterion – Problem solving using GA – Schema theorem		
Unit - IV	**Basic Concepts of Fuzzy Logic:**	**6**
Introduction to fuzzy logic - Classical sets and fuzzy sets - Fuzzy relations - Membership function - Features of membership function – Fuzzification - Fuzzy rules and reasoning - Fuzzy If-Then rules		
Unit - V	**Fuzzy Inference Systems (FIS):**	**6**
Introduction – Methods of FIS: Mamdani - Sugeno and Tsukamoto - Lambda- cuts for fuzzy sets and fuzzy Relations - Defuzzification Methods		

LIST OF EXPERIMENTS / EXERCISES:

1.	Study of Neural Network tool box -MATLAB
2.	Simulate an AND/OR network using Perceptron network with binary/bipolar input and targets
3.	Simulation of Back propagation network for a simple application
4.	Simulation of Kohenen’s network for clustering of data
5.	Study of Fuzzy tool box -MATLAB
6.	Miniproject using Fuzzy Inference System
7.	Miniproject using genetic algorithm for function minimization

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	S.Rajasekharan & G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Systems and Evolutionary algorithms: synthesis and applications", 2nd Edition, Prentice Hall of India, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:

1.	Timothy J.Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, John Wiley, New Delhi, 2010.
2.	Sivanandam S.N. & Deepa S.N, “Principles of Soft Computing”, 2nd edition, Wiley, New Delhi, 2014
3.	Sivanandam S.N, Sumathi S & Deepa S.N, "Introduction to Neural Networks using MATLAB 6.0", 1st Edition, Tata McGraw-Hill, New Delhi, 2006.
4.	Laboratory Manual
5.	MATLAB

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	illustrate the concepts of neural network	Applying (K3) , Precision (S3)
CO2	build neural network architecture using supervised and unsupervised learning algorithms	Applying (K3) , Precision (S3)
CO3	make use of genetic algorithm for function optimization	Applying (K3) , Precision (S3)
CO4	interpret the concepts of fuzzy logic	Applying (K3) , Precision (S3)
CO5	construct the three types of fuzzy inference system	Applying (K3) , Precision (S3)

Mapping of Cos with Pos and PSOs

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		3									
CO2	3	2	2		3	2	2	2	2	2		2	2	
CO3	3	2	2				2					2	2	
CO4	3	2	2		3	2	2	2	2	2		2	2	
CO5	3	2	2		3	2	2	2	2	2		2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30	-	-	-	100
CAT2	10	60	30	-	-	-	100
CAT3	10	70	20	-	-	-	100
ESE	15	65	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF09 - DSP PROCESSOR AND ITS APPLICATIONS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital signal Processing**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To understand the internal modules of the DSP processor and to implement real time applications	
Unit – I	**Introduction to Real-Time Digital Signal Processing**:	**6**
DSP hardware-DSP system design- Multiplier accumulator (MAC) – Modified bus structures and memory access in programmable DSPs – Multiple access memory – Multi-port memory – VLIW architecture – pipelining		
Unit – II	**Introduction to TMS320C67xx Digital Signal Processor**:	**6**
Fundamentals of programmable DSPs – Architecture of TMS320C67XX – Buses- Computational units- -On-chip peripherals-Timers and interrupts		
Unit – III	**TMS320C67xx Bus Architecture and Memory:**	**6**
Pipeline operation – Address generation units-Memory organization- Memory architecture –Addressing modes		
Unit – IV	**TMS320C67xx Programming**:	**6**
Instruction set-Assembly language instructions – DSP Tools : Assembler, Debugger, C compiler, Linker and Loader, Programming examples using C code with CCS		
Unit – V	**Peripheral Interfacing and Applications Using TMS320C67xx**:	**6**
Interfacing with serial I/O, A/D, D/A converters – FIR filter applications-Adaptive filter applications		

LIST OF EXPERIMENTS / EXERCISES:

1.	Perform Bit Reversal using TMS320C67xx DSK
2.	Implementation of convolution of 2 sequences using TMS320C67xx DSK
3.	Complex number multiplication using TMS320C67xx DSK
4.	Implementation of Radix-2 and Radix-4 FFT using TMS320C67xx DSK
5.	Computation of power density spectrum of a sequence
6.	MiniProject: Signal or Image Processing Application using TMS320C67xx DSK

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Venkataramani B. and Bhaskar M., “Digital Signal Processors: Architecture, Programming and Applications”, 2^{nd} Edition, McGraw Hill, New Delhi, 2011.

REFERENCES/ MANUAL / SOFTWARE:

1.	Texas Instrumentation, “User guides: Analog Devices”, Motorola Inc, Arizona, 2003.
2.	Sen M. Kuo, Bob H. Lee and Wenshun Tian, “Real-Time Digital Signal Processing: Implementations and Applications”, 2^{nd} Edition, John Wiley & Sons Ltd.,2006
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the basic concepts of real time DSP processor	Understanding(K2), Imitation (S1)
CO2	summarize the architectural concepts of C67xx processor	Understanding(K2), Manipulation (S2)
CO3	explain the internal memory organization of C67xx processor	Understanding (K2) , Manipulation (S2)
CO4	implement various digital signal processing algorithms using Code Composer Studio in simulation mode.	Applying(K3), Precision(S3)
CO5	use DSP hardware for digital signal and image processing applications	Applying(K3), Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3		1						1	2	
CO2	3	3	3	3		1						1	2	
CO3	3	3	3	3	3	2			2	2		2	3	
CO4	3	3	3	3	2	1			2	2		2	3	
CO5	3	2	3	3	3	2			2	2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	10	50	40	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF10 - DEEP LEARNING AND ITS APPLICATIONS							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Linear Algebra and Transforms, Probability and Stochastic process**	**6**	**PE**	**2**	**0**	**2**	**3**
Preamble	To develop the foundations of deep learning algorithms from as in perceptron to complex models used for image and text processing						
Unit- I	**Neurons:**						**6**
MPNeuron – Perceptron – Feed Forward Neural Network -Perceptron learning algorithm –Linear neurons and their Limitation - Sigmoid, Tanh, and ReLU neurons- Softmax output layer							
Unit- II	**Training Feed-Forward Neural Network:**						**6**
Gradient descent- The delta rule and learning rates- Gradient descent (GD) with sigmoidal neurons –Backpropagation algorithm							
Unit- III	**Optimization**:						**6**
Challenges with GD – Momentum based optimization - Nesterov accelerated GD – Stochastic and mini batch GD-learning rate adaptation							
Unit- IV	**Convolutional Neural Network:**						**6**
Vanilla deep neural networks- Filters and feature maps- Convolutional layer – Pooling – Batch normalization-Build for CIFAR-10							
Unit- V	**Sequential Neural Network:**						**6**
Analyzing variable-Length inputs- POS tagger- Recurrent neural networks – Vanishing gradient problem- LSTM unit, Gated recurrent unit- Sentiment analysis model							

List of Exercises / Experiments :

1.	Simulate perceptron of sigmoid neurons to show the behavioral changes on different weights and bias.
2.	Simulate to visualize through contour plot on different optimization techniques.
3.	Simulate to classify images using Convolutional neural networks
4.	Simulate to recognize hand written character using CNN
5.	Simulate to classify sentiment of text using 1DCNN/RNN
6.	Simulate Stock Price prediction application using LSTM
7.	MiniProject

Theory:-30, Practical:30,Total:60

TEXT BOOK:

1	Nikhil Buduma, “Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms”, 1st Edition, O’Reilly Media, 2017.

REFERENCES:

1	Ian Good fellow, “Deep Learning”,1st Edition, MIT Press, 2017.
2	Laboratory Manual
3	http://neural networks and deeplearning.com/

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use multilayer Perceptron and its learning algorithm for linearly non-separable problems.	Applying(K3), Imitation (S1)
CO2	apply the back propagation algorithms to learn the parameters of feed forward neural networks.	Applying(K3), Manipulation (S2)
CO3	use various optimization algo rithms to update model parameters.	Applying(K3) Precision(S3)
CO4	apply regularization and different hyper parameter tuning strategies to improve the performance of the models	Applying(K3), Precision(S3)
CO5	make use of CNN and RNN architectures to text and vision related application.	Applying(K3), Precision(S3)

Mapping of COs with POs and PSOs

COs,POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2				2			2	3	
CO2	3	2	2		2							2	3	
CO3	3	2	2	2	2	2						2	3	2
CO4	3	2	2	2	3	2		2				2	3	2
CO5	3	2	2	2	3	2		2	2	2		2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test , Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	6	60	34	-	-	-	100
CAT2	6	60	34	-	-	-	100
CAT3	14	70	16	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE07- WIRELESS BROADBAND COMMUNICATION							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Data Communication and Networking**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To explore IEEE 802.16- WiMAX broadband wireless communication and its associated techniques.	
Unit - I	**Wireless MAN :**	**9**
Evolution of broadband wireless -Spectrum options for broadband wireless-Technical challenges for broadband wireless- Background on iEEE802.16 and WiMAX- Salient features of WiMAX		
Unit - II	**Medium Access Control in Wireless MAN:**	**9**
Sub layers of the MAC layer of IEEE 802.16 –Service flows and connection – Frame structure – Open issues in IEEE 802.16- MAC layer of ETSI Hiper CCESS.		
Unit - III	**Radio Resource Management:**	**9**
Mesh mode operations – RRM in tree topology– RRM in mesh topology. **QoS in WiMAX Mesh Networks:** Services provisioning-QoS framework– QoS scheduling		
Unit - IV	**Mobility Management:**	**9**
Mobile WiMAX network - Idle-mode management- Anchored mobility management- (ASN and CSN). **Energy management:** PMP and mesh modes in IEEE 802.16 WiMAX**-** Sleep mode in the IEEE 802.16e- Energy consumption analysis with downlink, Uplink traffic and generalized traffic process.		
Unit - V	**IEEE 802.16j Multi-hop Relay Networks:**	**9**
Overview-Challenges- Tunneling and aggregation- Resource scheduling methods- Dimensioning cellular multi-hop 802.16 networks		
		Total :45

TEXT BOOK:

1.	Yan Zhang and Hsiao-Hwa Chen, "Mobile WiMAX : toward broadband wireless metropolitan area networks", Auerbach Publications, 2008.

REFERENCES:

1	M. K. Salman and Abid Yahya, "Mobile WiMAX Systems: Performance Analysis of Fractional Frequency Reuse", CRC Press, 2018.
2.	Bhavin S. Sedani, Komal R. Borisagar and Rohit M. Thanki, “WiMAX Modeling: Techniques and Applications”, Springer, 1st edition, 2020.
3.	Syed A. Ahson and Mohammad Ilyas, “WiMAX Handbook", CRC Press; 1st edition, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the functioning of fixed and mobile broadband MAC layer functionalities.	Understanding(K2)
CO2	apply suitable QoS framework and resource management of wireless broadband networks.	Applying(K3)
CO3	comprehend different energy efficient algorithms suitable for wireless broadband networks.	Understanding(K2)
CO4	apply the suitable methods in solving mobility related issues.	Applying(K3)
CO5	comprehend technical issues in Cellular Multi-hop 802.16 Networks.	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2								2		2	
CO2	3	2	2	2										
CO3	3	2	2	2	2					2	2	2		
CO4	3	2	2	2										
CO5	3	3	2	2	2								2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	60	25	-	-	-	100
CAT2	15	55	30	-	-	-	100
CAT3	15	60	25	-	-	-	100
ESE	10	65	25	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE08- NETWORK INFORMATION SECURITY							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Data communication and Networking	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide a broad overview on cryptographic algorithms, secure key management and distribution mechanism implemented in data communication networks.	
Unit– I	**Network Security Concepts:**	**9**
Computer security concepts - the OSI security architecture - Security attacks, Services and Mechanisms-Network security model - Divisibility and the division algorithm - Euclidean algorithm - Modular arithmetic -Groups, rings and fields, finite fields of the form GF(p),Polynomial arithmetic		
Unit– II	**Number Theory and Classical Encryption Techniques:**	**9**
Prime numbers - Fermat's and Euler's theorems- Testing for primality -The chinese remainder theorem- Discrete algorithms. - Classical encryption techniques: Symmetric cipher model - Substitution techniques - Transposition techniques		
Unit– III	**Symmetric Key Cryptography and Public Key Cryptography:**	**9**
Traditional block cipher - Data encryption standard - Block cipher principles- Block cipher modes of operation - Advanced Encryption Standard (AES-512) - Public key cryptography: Principles of public key cryptosystems-The RSA algorithm- Security of RSA		
Unit– IV	**Public-Key Cryptosystems:**	**9**
Diffie-Hellman key exchange-Elgamal cryptographic system- Elliptic curve arithmetic- Elliptic curve cryptography-Pseudorandom number generation based on an asymmetric cipher		
Unit– V	**Wireless and Email Security:**	**9**
Wireless security - Mobile device security - IEEE 802.11i Wireless LAN security - Email threats and comprehensive email security- S/MIME- Pretty good privacy- DNS security extensions -DDoS attacks		
		Total:45

TEXTBOOK:

1.	William Stallings, "Cryptography and Network Security",7th Edition, Pearson Education Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Behrouz A. Ferouzan & Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw-Hill, NewDelhi, 2015.
2.	Charles P.Fleeger, "Security in Computing",5th Edition, Prentice Hall, New Delhi, 2015.
3.	JieWang,"Introduction to Network Security: Theory and Practice",2nd edition, Wiley, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand OSI security architecture and mathematics of cryptography	Understanding (K2)
CO2	illustrate number theory and classical encryption techniques	Applying(K3)
CO3	apply knowledge in symmetric and public key cryptography	Applying(K3)
CO4	apply knowledge in public key cryptosystems	Applying(K3)
CO5	infer different wireless and email security mechanism	Understanding (K2)

Mapping of Cos with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**1**	**3**										**2**	
CO2	**2**	**1**	**3**										**3**	
CO3	**3**	**2**	**1**	**1**				**2**					**3**	**1**
CO4	**2**	**1**	**3**					**2**					**3**	
CO5	**3**	**3**	**2**	**2**				**3**					**3**	

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	60	20	-	-	-	100
CAT2	15	40	45	-	-	-	100
CAT3	15	60	25	-	-	-	100
ESE	15	45	40	-	-	-	100

*±3% may be varied (CAT1,2,3– 50 marks & ESE–100 marks)

22ECE09- REAL TIME OPERATING SYSTEM							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the concepts of real time operating system and to apply its concepts for embedded application development.	
Unit – I	**Introduction:**	**9**
Basic definitions – Foreground/Background systems – Shared resources – Multitasking – Tasks – Priority inversion problem – Context switches – Kernels – Scheduling approaches – FIFO – Non-preemptive and preemptive kernels – Round-Robin scheduling–Rate monotonic scheduling – Mutual exclusion – Deadlock – Synchronization – Event flags – Interrupts – Clock ticks – Advantages and disadvantages of real time kernels.		
Unit – II	**Task Management:**	**9**
Tasks –Task states – TCB – Task scheduling – Locking and unlocking the schedulers – Idle task – Statistics task - Creating tasks – Task stacks – Stack checking – Deleting a task– Changing a task's priority – Suspending task – Resuming task – Task query.		
Unit – III	**Time Management and Event Control Blocks:**	**9**
Delaying a task – Resuming a delayed task – System time - Event control blocks: Placing a task in the ECB wait list – Removing a task from an ECB wait list – Finding the highest priority task – List of free ECBs – Initialize – Task ready, Wait and time out of an event.		
Unit – IV	**Inter-task Communication Management:**	**9**
Semaphore Management: Creating – Deleting – Waiting – Signaling - Non-blocking and Query - Message Mailbox Management: Creating – Deleting – Waiting - Sending and getting a message - Query and using a mailbox as a binary semaphore, Message Queue Management: Creating – Deleting – Waiting - Sending (FIFO and LIFO) and getting a message – Flushing – Query - Using a queue when reading analog inputs and using a queue as a counting semaphore		
Unit – V	**Memory Management and Case Studies:**	**9**
Memory control blocks - Creating partition - Obtaining a memory block - Returning a memory block – Query - Memory partition and waiting for memory blocks from a partition - Porting µC/OS-II - Automatic chocolate vending machine		
		Total:45

TEXT BOOK:

1.	Jean J. Labrosse. µC/OS - II The Real Time Kernel, 2nd Edition, CMP Books, 2021.

REFERENCES:

1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley & Sons Inc., 2018
2.	Jonathan W. Valvano, "Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers", 5th Edition, Createspace Independent Publishers, 2019
3.	Rajkamal, "Embedded system- Architecture, programming and design", Mcgraw Hill, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	comprehend the fundamental concepts and scheduling algorithms for real time applications	Understanding (K2)
CO2	write task management codes for RTOS	Applying (K3)
CO3	use time management principles and write programs for RTOS	Applying (K3)
CO4	employ the principles of Inter-task communication services in operating systems	Applying (K3)
CO5	design real time embedded systems using the concepts of RTOS	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	2
CO2	3	3	2	2	3				2				3	2
CO3	3	2	2	2	3				2				3	2
CO4	3	2	2	2	3			2	2		2		3	2
CO5	3	2	2	2	3	2			2		2	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30	-	-	-	100
CAT2	15	35	50	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	10	45	45	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF11-SCRIPTING LANGUAGES FOR VLSI							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To apply the concept of script writing and customize and automate the synthesis flow. To perform database access to manipulate the netlist and write utilities for the TCL interface procedures.	
Unit – I	**Introduction to Scripting and PERL :**	**6**
Characteristics of scripting languages - Introduction to PERL - names and values - Variables and assignment - Scalar expressions - Control structures - Built-in functions - Collections of Data - Working with arrays - Lists and hashes - Simple input and output – Strings - Patterns and regular expressions - Subroutines - Scripts with arguments		
Unit – II	**Advanced PERL :**	**6**
Finer points of Looping – Subroutines - Using Pack and Unpack - Working with files - Navigating the file system - Type globs – Eval – References - Data structures – Packages - Libraries and modules – Objects-Objects and modules in action - Tied variables - Interfacing to the operating systems - Security issues.		
Unit – III	**TCL:**	**6**
The TCL phenomena – Philosophy – Structure – Syntax – Parser - Variables and data in TCL - Control flow - Data structures - Simple input/output – Procedures - Working with strings – Patterns - Files and Pipes - Example code		
Unit – IV	**Advanced TCL :**	**6**
The Eval – source, exec and up-level commands - Libraries and packages – Namespaces - Trapping errors - Event-driven programs - Making applications 'Internet-aware' - 'Nuts-and-bolts' internet programming - Security issues - Running untrusted code - The C interface		
Unit – V	**TK and JAVA Script :**	**6**
Visual toolkits - Fundamental concepts of TK - TK by example - Events and bindings - Geometry managers - PERL-TK. JavaScript – Object models - Design philosophy - Versions of JavaScript - The Java Script core language		

LIST OF EXPERIMENTS / EXERCISES:

1.	Write simple PERL/TCL Script for arithmetic expression evaluation and message printing
2.	Develop PERL/TCL Script to use decision making and looping statements
3.	Develop PERL/TCL Script to implements array functionalities
4.	Develop PERL/TCL Script to implement functions
5.	Develop PERL/TCL Script to implement strings.
6.	Develop TK and Java Script to implement VLSI testing environment
7.	Miniproject

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	David Barron, "The World of Scripting Languages", Wiley Publications, 2000.

REFERENCES/ MANUAL / SOFTWARE:

1.	Brent Welch, "Practical Programming in TCL and TK",4th Edition, 2003.
2.	Randal L. Schwartz, "Learning PERL", 6th Edition, O"Reilly, 2005.
3.	Guido van Rossum, and Fred L. Drake ", Python Tutorial, Jr., editor, Release 2.6.4, 2005.
4.	http:/www.cadence.com
5.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the concepts of PERL scripting languages	Understanding (K2), Imitation (S1)
CO2	articulate VLSI design using Perl scripting languages	Applying (K3), Precision(S3)
CO3	demonstrate the syntax of TCL scripting languages	Understanding (K2), Precision(S3)
CO4	employ advanced TCL script for advanced applications	Applying (K3), Precision(S3)
CO5	construct TK and Java Script scripting languages to automate synthetic flow	Applying (K3), Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2				3	3		3	3	3
CO2	3	2	3	3	2				3	3		3	3	3
CO3	2	2	3	3	3				3	3		3	3	3
CO4	3	2	3	3	3				3	3		3	3	3
CO5	2	2	3	3	3				3	3		3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	75	15	-	-	-	100
CAT2	10	75	15	-	-	-	100
CAT3	5	35	60	-	-	-	100
ESE	10	40	50	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE10 - QUANTUM COMPUTING AND INFORMATION

Programme & Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To infer the concepts of quantum information theory (qubits, quantum gates, and qubit systems) and to discuss quantum algorithms and physical realization of such system.	
Unit – I	**Fundamental concepts of Quantum Computing:**	**9**
Global perspectives-Quantum bits- Quantum computation: single qubit gates, multiple qubit gates, qunaum circuits, qubit copying circuit- Quantum information- Linear algebra-The postulates of quantum mechanics-Application:Superdense coding-EPR and the Belline quality		
Unit – II	**Quantum computation:**	**9**
Quantum algorithms- Single qubit operations - Controlled operations – Measurement - Universal quantum gates -Quantum circuit model of computation - Simulation of quantum systems- Quantum fourier transform- Phase estimation-Order finding and factoring - General applications of the quantum Fourier transform		
Unit – III	**Quantum search algorithms & physical realization**	**9**
The quantum search algorithm- Quantum search as a quantum simulation-Speeding up the solution of NP-complete problems-Quantum search of an unstructured database- Optimality of the search algorithm-Black box algorithm limits-Guiding principles-Conditions for quantum computation-Harmonic oscillator quantum computer-Optical photon quantum computer-Optical cavity quantum electrodynamics-ion traps-Nuclear magnetic resonance		
Unit – IV	**Quantum Information**	**9**
Classical noise and Markov processes -Quantum operations-Examples of quantum noise and quantum operations-Applications of quantum operations-Limitations of the quantum operations formalism-Distance measures for quantum information		
Unit – V	**Quantum error-correction**	**9**
Introduction-The Shor code-Theory of quantum error correction-Constructing quantum codes-Stabilizer codes-Fault-tolerant quantum computation: Fault-tolerant quantum logic-Fault-tolerant measurement and Elements of resilient quantum computation		
		Total:45

TEXT BOOK:

1.	Michael A. Nielsen & Isaac L. Chuang, “Quantum Computation and Quantum Information”,10th Edition, Cambridge University Press, 2010.

REFERENCES:

1.	Eleanor G.Rieffel, Wolfgang H.Polak, “Quantum Computing: A Gentle Introduction”, MIT Press, 2014.
2.	Scott Aaronson, “Quantum Computing since Democritus”, Cambridge University Press, 2013.
3.	Jonathan A,Jones, Dieter Jaksch, “ Quantum information, Computation and communication” Cambridge University Press, 1st Edition,2012

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the quantum mechanics using linear algebra	Understanding(K2)
CO2	paraphrase with qubits and designing of quantum gates	Understanding(K2)
CO3	interpret quantum parallelism using quantum search algorithms	Understanding(K2)
CO4	elucidate quantum information processing	Understanding(K2)
CO5	infer the concepts of quantum error correction	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2	2	
CO2	3	2	3									2	2	
CO3	2	2	2									2	2	
CO4	2	2	2									2	2	
CO5	2	2	2									2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	90	-	-	-	-	100
CAT2	10	90	-	-	-	-	100
CAT3	10	90	-	-	-	-	100
ESE	10	90	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECF12 – WAVELET TRANSFORM AND ITS APPLICATIONS							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Linear Algebra and Transforms**	**7**	**PE**	**2**	**0**	**2**	**3**

Preamble	To apply the various Wavelet Transform techniques on real time signals and images.	
Unit – I	**Wavelet Fundamentals:**	**6**
Vector spaces – Relationship between functions, Sequences, Vectors – Properties – Fourier transform and Non-stationary signals – Limitations – Review of sampling theorem.		
Unit – II	**Haar Wavelet:**	**6**
Analysis of Haar wavelet in function of scale and time – Haar multirate solution Analysis: Analysis part and Synthesis part – Frequency domain analysis of Haar filter bank		
Unit – III	**Continuous Wavelet Transform:**	**6**
The uncertainty principle – Time-bandwidth product – Time-Frequency tiling – STFT and wavelets – CWT-Comparison of STFT and CWT–Interpretation of spectrogram plot.		
Unit – IV	**Discrete Wavelet Transform:**	**6**
Dyadic MRA Theorem – Inverse DWT computation – Bi-orthogonal and orthogonal filter banks – Construction of orthogonal filter bank – Variants of MRA: Splines and wavelet packets.		
Unit – V	**Applications:**	**6**
Compression – Denoising – Analysis of biomedical signals and images using wavelets		

LIST OF EXPERIMENTS / EXERCISES:

1.	Implementation of signals in continuous and discrete wavelet transform domains.
2.	Configuration of multi-level wavelet decomposition of a signal and extract approximation and detail coefficients.
3.	Designing Bi-orthogonal and orthogonal filter banks using wavelet Transform.
4.	Implementation of empirical wavelet transforms for 1D and 2D signals.
5.	Detection of R-Peaks in ECG signal using Wavelet Transform.
6.	Denoising the user given images using DWT with different decomposition levels.
7.	Filtering a signal using wavelet signal denoising toolbox.
8.	Compressing the signals and images using Wavelet transform
9.	Implementation of Haar wavelet transform for signals and images
10.	Interpret the image spectrogram plot.

Lecture:30, Practical: 30, Total: 60

TEXT BOOK:

1.	Soman K.P. and Ramachandran K.I., "Insight into Wavelets - From Theory to Practice", 3rd Edition, Prentice Hall of India, 2013.

REFERENCES/ MANUAL / SOFTWARE:

1.	Rao R.M. and Bopardikar A.S., "Wavelet Transforms: Introduction to Theory and Applications", Addison Wesley, Reprint, 2012.
2.	Mallat S., "A Wavelet Tour of Signal Processing: The Sparse Way", 3rd Edition, Academic Press, 2009.
3.	Vikram M Gadre and Aditya S Abhyankar, "Multiresolution and Multirate Signal Processing", McGraw Hill Education, 1st Edition,2017
4.	Laboratory Manual

COURSEWARE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the fundamentals of vectors spaces and properties	Understanding (K2), Precision (S3)
CO2	apply haar wavelet and daubechies wavelet on discrete samples	Applying (K3) , Precision (S3)
CO3	utilize continuous wavelet transform for the interpretation of spectrum plots.	Applying (K3), Precision (S3)
CO4	experiment with discrete wavelet transform of orthogonal filter banks.	Applying (K3), Precision (S3)
CO5	demonstrate the application of different wavelet on biomedical signals and images.	Understanding (K2), Precision (S3)

Mapping of Cos with Pos and PSOs

CosKPos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			**3**				**3**	**3**				
CO2	3	2	2	2	**3**				**3**	**3**			2	
CO3	3	2	2	2	**3**				**3**	**3**			2	
CO4	3	2	2	2	**3**				**3**	**3**			2	
CO5	2	1			**3**				**3**	**3**			3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	20	70	10	-	-	-	100
CAT 2	10	80	10	-	-	-	100
CAT 3	10	80	10	-	-	-	100
ESE	10	80	10	-	-	-	100

* ±3% may be varied (CAT 1,2,3– 50 marks & ESE – 100 marks)

22ECF13 – COMPUTER VISION

Programme & Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	2	0	2	3

Preamble	To understand and utilize the intelligent algorithms which can perform/mimic the task of human visual perception.	
Unit – I	**Image Formation:**	**6**
Image Formation – Geometric primitives and transformations-2D–transformations-3D transformations-Photometric image formation-Lighting-Reflectance and shading-Sampling and aliasing-Color		
Unit – II	**Feature Detection:**	**6**
Points and patches-Feature detectors-Feature descriptors-Feature matching-Edges and contours-Contour tracking-Lines and vanishing points-Successive approximation		
Unit – III	**Segmentation:**	**6**
Active Contours: Snakes – Dynamic Snakes – Level Sets –Split and merge: Watershed – Region splitting-Region merging-Graph-based segmentation-Mean shift and mode finding-K-means and mixtures of Gaussians		
Unit – IV	**Object Classification:**	**6**
Support Vector Machines –Linear classification – Separable case – Multi class classification: Multiclass classification problem- Multiclass SVMs- Multiclass boosting algorithms		
Unit – V	**Recognition:**	**6**
Object detection- Face recognition- Instance recognition- Category recognition- Recognition databases and test sets		

EXPERIMENTS:

1.	Conversion of Color image into graysacle image and display R,G, B channel form color image
2.	Display of colour Image and perform shifting, rotations and scaling using python
3.	Extracting grayscale pixel value and edges of the image using python
4.	Image segmentation using contour detection using python
5.	Image segmentation using k means algorithm
6.	Simulate neural network back-propagation using python
7.	Build a CNN model to perform face recognition using Keras
8.	MiniProject

Lecture:30 Practical :30 Total:60

TEXT BOOK:

1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”, 2nd Edition, Springer, NewYork, 2011.

REFERENCES:

1.	M Mohri, A Rostamizadeh& A Talwalkar, “Foundations of Machine Learning”, 2nd Edition, MIT Press, USA, 2018.
2.	Stanford Lecture Notes at https://cs231n.github.io/convolutional-networks/
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the various spatial transformations on the image	Applying (K3) , Precision (S3)
CO2	make use of various feature detector and matching techniques	Applying (K3) , Precision (S3)
CO3	make use of various established segmentation algorithms for a specific task	Applying (K3) , Precision (S3)
CO4	apply linear classification algorithms for image classification and recognition	Applying (K3) , Precision (S3)
CO5	model artificial neural networks and deep convolutional neural networks for face recognition	Applying (K3) , Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2				2			2	3	2
CO2	3	2	2	2	2							2	3	2
CO3	3	2	2	2	3							2	3	2
CO4	3	2	2	2	3				2			2	3	2
CO5	3	2	2	2	3				2			2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30	-	-	-	100
CAT2	10	50	40	-	-	-	100
CAT3	15	55	30	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE11- EDGE COMPUTING							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	ThIS course provides information on the different types of edge compute deployments, different types of edge compute services (such as CDN Edge, IOT Edge, and Multi-access Edge (MEC)).	
Unit – I	**IoT and Edge Computing:**	**9**
History of the IoT-IoT potential-Definition of the IoT-Example use case and deployment. Edge Computing: Edge purpose and definition-Edge use cases-Edge Hardware Architectures-Operating Systems-Edge platforms-Use cases for Edge computing-		
Unit – II	**Edge routing and Networking and Edge to cloud protocols:**	**9**
TCP/IP network functions at the edge-Edge-level Network security-Software defined networking. Protocols-MQTT-MQTT-SN-Constrained application protocol-Other protocols-Protocol summary and comparison		
Unit – III	**Cloud and Fog Topologies**	**9**
Cloud services model-Public, private, and hybrid cloud-The open stack cloud architecture-Constraints of cloud architectures for IoT-Fog computing		
Unit – IV	**Data Analytics and Machine Learning in the cloud and Edge:**	**9**
Big data Analytics in IoT-Machine Learning in IoT-IoT data Analytics and machine learning comparison and assessment.		
Unit – V	**IoT and Edge Security**	**9**
Cybersecurity vernacular-Anatomy of IoT cyber attacks-Physical and hardware security-Shell security-Cryptography-Software-Defined Perimeter-Block chain and crypto currencies in IoT-Government regulations and Intervention-IoT Security best practices.		
		Total:45

TEXT BOOK:

1.	Perry Lea , " IoT and Edge Computing for Architects ", 2nd Edition, Packt Publishing, 2020.

REFERENCES:

1.	Rajkumar Buyya, Satish Narayana Srirama, "Fog and Edge Computing: Principles and Paradigms ", wiley publication, 2019.
2.	David Jensen, “Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge", MICROSOFT AZURE.
3.	Simon Monk ," Raspberry Pi Cookbook ",3rd Edition, O'Reilly Media, Inc., 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Describe the concept of edge computing	Understanding (K2)
CO2	Describe the architecture and its implementation in various case studies	Understanding (K2)
CO3	Experiment with Raspberry pi for implementation of edge computing	Applying(K3)
CO4	Choose the interfacing Protocols for improved performance of edge computing	Applying(K3)
CO5	Implement the edge computing in Internet of things	Applying(K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2											
CO2	3	2	2											
CO3	3	2	2		2									
CO4	3	2	2		2			2	2					
CO5	3	2	2		2			2	2					

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	I9	70	10	-	-	-	100
CAT2	20	50	30	-	-	-	100
CAT3	20	50	30	-	-	-	100
ESE	25	45	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE12 SATELLITE COMMUNICATION							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Analog and Digital Communication**	**7**	**PE**	**3**	**0**	**0**	**3**
Preamble	To understand the basic terminologies related to satellites, various sub systems, multiple access techniques and applications of a satellite.						
Unit– I	**Overview of Satellite Systems:**						**9**
Introduction–Frequency allocations for satellite services–Kepler's law–Definitions of terms for earth orbiting satellites–Orbital elements–Apogee and Perigee heights–Orbital perturbations–Effects of a non spherical earth–Atmospheric drag–Inclined orbits–Calendars–The Orbital plane–The Geocentric equatorial coordinate system–Earth station referred to the IJK frame–The topocentric horizon coordinate system-The subsatellite point.							
Unit– II	**Geostationary Orbit and Space Segment:**						**9**
Antenna look angles – Limits of visibility - Earth eclipse of satellite – Sun transit outage – Launching orbits – Attitude control – Station keeping - telemetry, tracking and command sub system - Transponders – Wide band amplifier – Input demultiplexer – Power amplifier.							
Unit– III	**Earth Segment & Space Link:**						**9**
Earth Segment: Introduction–Receive only home TV systems –Outdoor unit-Indoor unit for analog (FM)TV–MATV system–CATV system–Transmit receive earth stations - Space link: Equivalent isotropic radiated power–Transmission losses-Link power budget equation–Carrier to noise ratio–Uplink C/N–Downlink C/N–Effects of rain							
Unit– IV	**Satellite Access:**						**9**
Single access — Preassigned FDMA- Demand assigned FDMA- SPADE system TDMA: Reference burst - Preamble and Postamble- Carrier recovery- Network synchronization-Unique word detection- Traffic data- Frame efficiency and channel capacity- Preassigned TDMA- Demand assigned TDMA- Code division multiple access–Space division multiple access.							
Unit– V	**Satellite systems:**						**9**
INMARSAT:VSAT Systems: Network architectures, Access control, Multiple access selection - Overview of Radarsat and GEOSAT-Study of recently launched GEOSAT and its applications.							
							Total:45

TEXTBOOK:

1.	Roddy Dennis, Satellite Communications”,4th Edition, Mc-Graw Hill, New York, 2017.

REFERENCES:

1.	Varsha Agrawal and Anil K.Maini, “Satellite Communications”,1st Edition, Wiley India Pvt. Ltd., New Delhi,2010.
2.	Pratt Timothy, Bostian Charles and Allnutt Jeremy, “Satellite Communications”,3rd Edition, Wiley India Private Limited, New Delhi, 2019.

COURSEOUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest-level)**
CO1	interpret the various terminologies in satellite communication problems	Understanding(K2)
CO2	comprehend the working of various sub systems of a satellite	Applying(K3)
CO3	make use of terminal stations to broadcast the programmes through satellite earth stations and understand the effect of losses	Applying(K3)
CO4	describe different access methodologies of satellite communication	Understanding(K2)
CO5	illustrate the different types of satellite based on applications	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2	2	2								2	2	
CO3	3	2		2								2	2	
CO4	3	2		2		2		2				2	2	
CO5	3	2	2	2		2		2				2	2	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN -THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	40	60	-	-	-	-	100
CAT 2	20	55	25	-	-	-	100
CAT 3	20	80	-	-	-	-	100
ESE	20	60	20	-	-	-	100

*±3% may be varied (CAT1,2,3–50 marks & ESE–100 marks)

22ECE13- WIRELESS NETWORKS

Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Data Communication and Networking**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To acquire broad overview on various wireless standards, technologies and functionalities of TCP / IP suite in wireless systems.	
Unit– I	**Wireless Local Area Network(WLAN):**	**9**
Introduction to 802.11 - Emerging IEEE802.11 Standards - Wireless LAN Topologies - Establishing a wireless connection - Physical Layer - Packet structure and Packet types		
Unit– II	**WLAN QoS:**	**9**
Channel access - Admission control - Power management - QoS in Wireless mesh networks		
Unit– III	**WLAN MAC:**	**9**
IEEE 802.11MAC protocol - MAC enhancements for QoS support - Performance understanding of IEEE 802.11e EDCA - IEEE802.11n standard.		
Unit– IV	**High Speed WLAN:**	**9**
Introduction to 802.11ac, Core technology of 802.11 ac, Radio channels in 802.11ac, Transmission: Modulation, Coding, and Guard interval - PHY-Level framing, Transmission and reception process, 802.11ac data rates.		
Unit– V	**IEEE80211.ac (MAC):**	**9**
Framing - Medium access procedures - Beamforming basics - Single-User Beamforming, Multi-User(MU) Beamforming - Building an 802.11ac network- 802.11ax overview		
		Total:45

TEXTBOOKS:

1.	Benny Bing, “Emerging Technologies in Wireless LANs Theory, Design, and Deployment”, 1st Edition, Cambridge University Press, 2008, for Units I, II, III.
2.	Matthew S. Gast, “802.11ac:A Survival Guide”,1st Edition, O’Reilly,2013, for Units IV, V.

REFERENCES:

1.	Yang Xiao and Yi Pan “Emerging Wireless LANs Wireless PANs and Wireless MANs”, Wiley, 2021
2.	Mooi Choo Chuah and Qinqing Zhang, “Design and Performance of 3G Wireless Networks and Wireless LANs”, Springer, 2021.

COURSEOUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline various wireless standards and technologies	Understanding(K2)
CO2	comprehend the functionalities of QoS in WLAN systems	Understanding(K2)
CO3	apply the MAC layer techniques to improve WLAN throughput performance	Applying(K3)
CO4	comprehend various high throughput wireless technologies	Understanding(K2)
CO5	apply different concepts in IEEE 80211.ac MAC layer	Applying(K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1	PO12	PSO1	PSO2
CO1			2	2	2	3							3	
CO2	3	2	2			2						1	3	2
CO3	3	2		2	2	2							3	2
CO4	3	2				2							3	2
CO5	3	3	2	2	1	2					1		3	3

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	60	20	-	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	15	60	25	-	-	-	100

*±3% may be varied(CAT1,2,3–50 marks & ESE–100 marks)

22ECE14- RISC ARCHITECTURE								
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the architecture of ARM Cortex Microprocessor and also implement basic Interfacing Applications using ARM Cortex.	
Unit – I	**ARM Cortex M Processors:**	**9**
Overview of Cortex M Processors- Advantages- Evolution- Architecture : Programmer's model- Application Program status register-System control Block- Resets- Exceptions and interrupts		
Unit – II	**CMSIS Standard and Cortex M Programming**:	**9**
Software development flow- Software flow- Inputs, outputs, and peripherals accesses- Microcontroller interfaces–Introduction to Cortex Microcontroller Software Interface standard (CMSIS)- Organization and standardization of CMSIS core- Usage and benefits-Versions of CMSIS.		
Unit – III	**Memory System and Interrupts:**	**9**
Memory system features overview- Memory maps- Memory endianness- Memory access attributes- Default memory access permissions- Bit-band operations- Unaligned transfers- Exclusive accesses - Exception types - Interrupt management- Priorities- Exception sequence- NVIC and SCB registers for exception control- Registers for interrupt masking.		
Unit – IV	**Floating Point:**	**9**
Single precision- half precision and double precision floating point numbers- Floating point unit- Overview and registers- Lazy stacking - DSP applications using FPU		
Unit – V	**Embedded OS and Keil MDK:**	**9**
Getting started with uVision- Project options- Using IDE and debugger- Optimization options- Keil RTX real time kernel - CMSIS- OS - examples on Semaphores- Mutual exclusion- Message queue- Mail queue- Timer and signal event communication- OS aware debugging		
		Total:45

TEXT BOOK:

1.	Joseph Yiu, "The Definitive Guide to ARM_ Cortex_-M3 and Cortex-M4 Processors", 3rd Edition, Newnes, USA, 2014.

REFERENCES:

1.	Trevor Martin, "The Designer's Guide to the Cortex-M Processor Family- A tutorial Approach", 1st Edition, Newnes, USA, 2013.
2.	Trevor Martin, "The Insider's Guide to the STM32 ARM Based Microcontroller", 1st Edition, Hitex(UK) Ltd, UK, 2008.
3.	http://infocenter.arm.com/help/topic/com.arm.doc.ddi0439b/DDI0439B_cortex_m4_r0p0_trm.pdf

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the features and architecture of ARM Cortex M processor	Understanding (K2)
CO2	explain the role of CMSIS core in ARM Cortex programming	Understanding (K2)
CO3	Summarize the different memory system configurations and interrupt schemes	Understanding (K2)
CO4	develop application programs using in ARM Cortex	Applying (K3)
CO5	build OS based applications on ARM Cortex M using Keil MD	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2	3										2	
CO3	3	2										3		
CO4	3	3	2	2					2	2	3	3	2	2
CO5	3	2	3	2	3	2	2	2	3	3	3	3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	15	50	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE15 - SYSTEM VERILOG							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**VLSI Design**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge on designing and verification of Integrated Circuits using System Verilog	
Unit – I	**Introduction to System Verilog:**	**9**
The Verification process - Basic testbench functionality - Directed testing - Constrained-random stimulus - functional coverage - Testbench components - Layered Test bench - Building a layered Testbench - Simulation environment phases		
Unit – II	**Data Types:**	**9**
Built-in data types - Fixed-size arrays - Dynamic arrays - Queues - Associative arrays - Linked lists - Array methods - Choosing a storage type - Creating new types with typedef - Creating user-defined structures - Enumerated types - Constants - Strings - Expression width - Net types		
Unit – III	**Procedural Statements, Routines and Basic OOP:**	**9**
Procedural statements - Tasks, functions and Void functions - Routine arguments - Returning from a routine - Local data storage - Time values - OOP terminology - Creating new objects - Static variables vs Global variables - Class methods - Scoping rules - Understanding dynamic objects - Building a testbench.		
Unit – IV	**Connecting the Test bench and Design:**	**9**
Introduction - Separating the testbench and design - The interface construct - Stimulus timing - Interface driving and sampling - Top level scope - Program module interactions - System verilog assertions - The four-port ATM router –Directed test for the LC3 fetch block		
Unit – V	**Randomization:**	**9**
Randomization in system verilog - Constraint details - Controlling multiple constraint blocks - Valid constraints - In-line constraints - The prerandomize and postrandomize functions - Constraints tips and techniques - Iterative and array constraints - Random control - Random generators - Random device configuration.		
		Total:45

TEXT BOOK:

1.	Chris Spear, "System Verilog for Verification: A Guide to Learning the Testbench Language Features", 2nd Edition, Springer, 2012.

REFERENCES:

1.	Stuart Sutherland, Simon Davidman and Peter Flake ,System Verilog for Design: A Guide to Using System Verilog for Hardware Design and Modeling, 2nd Edition, , Springer, 2010.
2.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and synthesis", 2nd Edition, Pearson Education, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the components of test bench	Understanding (K2)
CO2	demonstrate System verilog data types	Understanding (K2)
CO3	illustrate the procedural statements, tasks and functions using OOPS concepts	Applying (K3)
CO4	build a test bench environment and test the design under test	Applying (K3)
CO5	construct the constrained random coverage driven verification in System verilog Environment	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2									2	3	2
CO2	3		2									2	3	2
CO3	3		2									2	3	2
CO4	3		2									2	3	2
CO5	3		2									2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	90	-	-	-	-	100
CAT2	5	45	50	-	-	-	100
CAT3	5	35	60	-	-	-	100
ESE	10	40	50	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE16 - NEURAL SCIENCE FOR ENGINEERS

Programme &Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the functioning of the nervous system and apply the engineering opportunities in developing technologies for understanding the functioning of the nervous system.	
Unit– I	**Molecular Biology of Cells of the Nervous system**	**9**
Introduction to the nervous system and basic structure of the nervous system - The cells of the nervous system - ion channels - Membrane potential and the passive electrical properties of the neuron - Propagated signaling – The action potential - Evolutionary lessons in nervous system function and hierarchy of neural function from the cell to large networks.		
Unit– II	**Synaptic Transmission:**	**9**
Overview of synaptic transmission, Signalling at the nerve muscle synapse - Directly gated transmission - Synaptic integration in the central nervous system - Modulation of synaptic transmission-Second messengers-Tansmitter release, neurotransmitters-Diseases of the nerve and motor unit		
Unit– III	**Neural basis of Cognition:**	**9**
The organization of the central nervous system - Functional organization of perception and movement from nerve cells to cognition-Internal representation of space and action- Organization of cognition-Cognitive functions of the premotor systems-Functional imaging of cognition		
Unit– IV	**Constructive nature of visual processing:**	**9**
Low level visual processing-The retina - Intermediate level visual processing and visual primitives - High level visual processing-Cognitive influences -Visual processing and action, inner ear - Auditory central nervous system- Smell and taste- The chemical sense		
Unit– V	**Computational Neurobiology and Neuro Biopotential**	**9**
Computational Neurobiology: Brain-Computer Interfaces: Neuro modulation and recordings: Brain-Computer Interfaces (BCI) devices and systems, Introduction to BCI devices for neural recording and stimulation. **Neuro Biopotential:** Introduction to neuro-biopotentials: EEG, EMG and ECoG - Introduction to biopotentials - Data acquisition, Signal acquisition - Conditioning, and processing		
		Total:45

TEXTBOOK:

1.	Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, Steven A. Siegelbaum, A. J. Hudspeth, Sarah Mack, “Principles of Neural Science”, 5th Edition, McGrawHill,2013.

REFERENCES:

1.	Pallas-Areny,R .and Webster,J.G., “Sensors and signal conditioning”.1st Edition, John Wiley&Sons,2012
2.	Steven J.Luck, “An Introduction to the Event-Related Potential Technique”, 1st Edition, Oxford handbook,2005
3.	https://onlinecourses.nptel.ac.in/noc22_ee66

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the concepts of cell biology of the nervous system	Understanding(K2)
CO2	comprehend the functionalities of neuro transmitter	Understanding(K2)
CO3	interpret the representation and functions of cognition	Understanding(K2)
CO4	describe the significance of auditory central nervous system	Understanding(K2)
CO5	outline the importance of neuro biopotential and neurobiology	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			2						2		2
CO2	3	2	2	2		2						2		
CO3	3	2	2	2		2						2		2
CO4	3	2	2	2	2	2		2				2		2
CO5	3	2	2	2	2	2		2				2		2

1–Slight,2–Moderate,3–Substantial, BT-Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT 2	30	70	-	-	-	-	100
CAT 3	30	70	-	-	-	-	100
ESE	30	70	-	-	-	-	100

*±3% may be varied (CAT 1,2,3– 50 marks & ESE –100 marks)

22ECE17 - REMOTE SENSING							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the fundamental concepts of Remote Sensing, types, Image processing techniques used to process the satellite data, GIS and applications Remote Sensing.	
Unit - I	**Concepts and Foundations of Remote Sensing :**	**9**
Energy sources and radiation principles - Energy interactions in the atmosphere-Energy interactions with earth surface features, Data acquisition and digital image concepts- Data capturing mechanisms: Along track scanning, Across track scanning		
Unit - II	**Earth Resource Satellites Operating in the Optical Spectrum:**	**9**
General characteristics-Moderate resolution systems- Landsat -1 to -7,Landsat -8, SPOT-1 to -5,SPOT-6 to -7-High resolution satellite system- Space station remote sensing.		
Unit - III	**Microwave and LIDAR sensing:**	**9**
Radar development-Imaging radar system operation-Synthetic aperture radar-Geometric characteristics of radar Imagery-Basic principles of Lidar- Lidar data analysis and applications- Spaceborne Lidar.		
Unit - IV	**Digital Image Analysis :**	**9**
Preprocessing of images-Image enhancement-Contrast manipulation-Spatial feature manipulation-Image classification-Supervised classification-Unsupervised classification-Data fusion and GIS integration..		
Unit - V	**Remote Sensing Applications:**	**9**
Landuse/ Landcover mapping-Agricultural applications-Water resource applications-Urban and regional planning applications-Archaeological applications-Environmental assessment and protection-Natural disaster assessment.		
		Total:45

TEXTBOOK:

1. Thomas M.Lillesand, Ralph W.Kiefer, "Remote Sensing And Image Interpretation", 7th Edition, John Wiley, New Delhi, 2015.

REFERENCES:

1. John R. Jensen, “Remote Sensing Of The Environment – An Earth Resource Perspective”, Pearson Education Series, 2003.
2. Rafael C.Gonzalez, Richard E.Woods, “Digital Image Processing”, 3rd Edition, Prentice Hall, 2007.
3. Robert A. Schowengerdt, Remote Sensing Models & Methods For Image Processing, 3rd Edition, 2004.

COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the electromagnetic remote sensing process and data capturing mechanisms.	Understanding (K2)
CO2	explain the earth resource satellites operating in the optical spectrum	Understanding (K2)
CO3	develop the different types remote sensing systems, data generated and their characteristics in terms of resolutions.	Applying (K3)
CO4	identify the appropriate image processing technique to process satellite data with GIS for solving societal issues.	Applying (K3)
CO5	select and process the satellite data for real time applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	1			1									
CO3	3	1			1									
CO4	3	2	1		2	2	1	2	2	1		1	2	1
CO5	3	2	1		2	3	2	2	2	1		2	2	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT 2	20	60	20	-	-	-	100
CAT3	20	50	30	-	-	-	100
ESE	20	60	20	-	-	-	100

*±3% may be varied (CAT 1,2,3 – 50 marks & ESE–100 marks)

22ECE18 - NATURAL LANGUAGE PROCESSING

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Linear algebra and transforms , Python Programming**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To model the computer to perform useful tasks involving human language, task like conversational agent, dialogue system, machine translation, question and answering	
Unit- I	**Computer Language Processing and Regular Expressions:**	**9**
Knowledge in speech and language processing – Ambiguity - Models and algorithms - Turing Test, Basic regular expression patterns – Disjunction – Grouping and precedence		
Unit- II	**Text Tokenization and Normalization:**	**9**
Words – Corpora - Word tokenization and normalization - Word segmentation - Sentence segmentation - Minimum edit distance algorithm		
Unit- III	**Language Modeling:**	**9**
N-Grams - Evaluating language model - Sampling sentences from a language model - Generalization and zeros - Smoothing algorithm		
Unit- IV	**Logistic Regression as Language Model:**	**9**
Training the Naïve Bayes - Optimizing for sentimental analysis - Naïve Bayes as language modeling - Evaluation of model		
Unit- V	**Neural Language Models:**	**9**
Words and Vectors - Cosine similarity - TF-IDF weighting terms in vector - Application of the TF-IDF vector model		
		Total:45

TEXTBOOK:

1. Jurafsky, Daniel Martin& James H, "Speech and Language Processing- An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 3rd Edition, Pearson Education India, New Delhi, 2019.

REFERENCES:

1. Eisenstein & Jacob, "Natural Language Processing", 1st Edition, MIT Press, USA, 2019.
2. Palash Goyal, Sumit Pandey & Karan Jain, "Deep Learning for Natural Language Processing: Creating Neural Networks with python", 1st Edition, Apress Media, NewYork, 2018.

COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand the concept of speech and language processing for intelligent agent	Understanding (K2)
CO2	Understand the pattern of regular expressions to search in texts	Understanding (K2)
CO3	Apply the text pre-processing technique using NLTK library	Applying (K3)
CO4	Assign probability to predict word from preceding words using sklearn library	Applying (K3)
CO5	Apply text categorization task of sentimental analysis using generative classifier using sklearn library	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2												
CO3	3	2	2	2	3				2				2	2
CO4	3	2	2	2	3	2		2	2				2	2
CO5	3	2	2	2	3	2		2	2				2	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN -THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT2	10	40	50	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	10	50	40	-	-	-	100

*±3% may be varied (CAT 1,2,3 – 50 marks & ESE–100 marks)

22ECE19 - BLOCKCHAIN TECHNOLOGY								
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	Block chain is a public digital ledger to share information in a trustworthy and secure way. Blockchain rely ona peer-to-peer network that no single party can control.	
Unit – I	**Blockchain 101:**	**9**
Distributed systems – The history of blockchain – Introduction to blockchain – definitions – elements – Features – Applications ofblockchain technology – Tiers – Types of blockchain – Consensus in blockchain – CAP theorem – Benefits and limitations ofblock chain.		
Unit – II	**Decentralization, Cryptography and Technical Foundations:**	**9**
Introduction – Cryptography – Confidentiality – Integrity – Authentication – Cryptographic primitives – Asymmetric cryptography –Public and private keys – RSA – Discrete logarithm problem – Hash functions – Elliptic Curve Digital signature algorithm.		
Unit – III	**Consensus and Smart contracts in Blockchain:**	**9**
Components and structure of blockchain blocks-Digital Signature-Distinction between decentralization versus distributed system-Consensus in blockchain-proof of work-proof of stake-proof of authority- proof of elapsed time-smart contracts-smart contract approaches-Limitations of smart contacts-alternate blockchains and various uses of blockchain.		
Unit – IV	**Ethereum 101:**	**9**
Introduction – Ethereum blockchain – Elements of the ethereum blockchain – Precompiled contracts – Accounts – Block – Ether –Messages – Mining - Clients and wallets – The Ethereum network –Ethereum Development.		
Unit – V	**Hyperledger:**	**9**
Projects – protocol – Hyperledger Fabric – Sawtooth lake – Corda – Blockchain – Outside of Currencies: Internet of Things –Government — Health — Finance.		
		Total:45

TEXT BOOKS:

1.	Imran Bashir, "Mastering Blockchain Distributed ledgers, decentralization and smart contracts Explained", Packt Publishers, 2017 for Unit I, II
2.	Brenn Hill, Samanyu Chopra & Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", Packt Publishers, 2018 for Units III, IV, V.

REFERENCES:

1.	Chandramouli Subramanian,Asha A George,Abhilash K A and Meenakarthikeyan,"Blockchain Technology" 1st edition,Universities Press (India) -2020.
2.	Andreas Antonopoulos, "Mastering Bitcoin: Programming the open blockchain", 2nd Edition, O"Reilly Media, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	recall the history and different applications of blockchain	Understanding (K2)
CO2	illustrate decentralization and practical aspects of cryptography	Understanding (K2)
CO3	interpret bitcoin technology, alternative coins and smart contracts	Understanding (K2)
CO4	develop a distributed application using Ethereum	Applying (K3)
CO5	construct an application using Hyperledger	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**											**2**	**2**	
CO2	**3**											**2**	**2**	
CO3	**3**											**2**	**2**	
CO4	**3**	**2**	**2**	**2**								**2**	**2**	
CO5	**3**	**2**	**2**	**2**								**2**	**2**	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	85	-	-	-	-	100
CAT 2	15	85	-	-	-	-	100
CAT3	15	55	30	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE20 - NEXT GENERATION WIRELESS COMMUNICATION SYSTEMS

Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Analog and Digital Communication**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To endow the key technologies of 5G wireless communication systems and beyond	
Unit – I	**5G Use Cases:**	**9**
Mobile communications generations: from 1G to 4G - Introduction to enhanced mobile broadband - Internet of Things related to 5G - Use cases and requirements - 5G system concept		
Unit – II	**5G architecture:**	**9**
Introduction - High-level requirements for the 5G architecture - Functional architecture and 5G flexibility - Fundamental techniques for Machine type communication – Massive machine type communication – Device to device communication from 4G to 5G		
Unit – III	**Millimeter Waves for next generation Wireless Communication:**	**9**
Spectrum and regulations - Channel propagation - Hardware technologies for mmW systems - Architecture and mobility – Beamforming - Physical layer techniques		
Unit – IV	**Radio Access Technologies:**	**9**
Multi-carrier with filtering: A new waveform - Non-orthogonal multiple access - Radio access for dense deployments - Radio access for V2X communication - Radio access for massive machine-type communication		
Unit – V	**Massive MIMO Systems:**	**9**
Single user MIMO- Multiuser MIMO – Pilot design for Massive MIMO – Resource allocations and transceiver algorithms - Baseband and RF implementations		
		Total:45

TEXT BOOK:

1.	Afif Osseiran, “5G Mobile and Wireless Communication Technology”, 1st Edition, Cambridge University Press, New Delhi, 2016.

REFERENCES:

1.	Athanasios G. Kanatas, "New Directions in Wireless Communications Systems from Mobile to 5G", 1st Edition, CRC Press 2018, New Delhi
2.	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", 1st Edition, CRC Press 2019, New Delhi
3.	George Tsoulos, “MIMO System Technology for Wireless Communications”, 1st Edition, CRC Press 2006, New Delhi

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the use cases of next generation wireless communication	Understanding (K2)
CO2	explain the architecture of 5G systems	Understanding (K2)
CO3	interpret the applications of millimetre wave technology for next generation wireless systems	Understanding (K2)
CO4	identify the radio access technologies for next generation wireless communication	Understanding (K2)
CO5	summarize the use of massive MIMO for next generation wireless systems	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2							2	2				
CO2	3	2		2					2	2	2			
CO3	3	3	2	2				2	2	2		2	2	
CO4	3	3	2	2					2	2	2	2	2	
CO5	3	3	2	2				2	2	2		2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	20	80	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE21- RADAR ENGINEERING							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Antenna and Wave Propagation**	**7**	**PE**	**3**	**0**	**0**	**3**
Preamble	To gain knowledge in the different types of radar systems used for air-traffic control, long range surveillance and early-warning systems						
Unit– I	**Radar and Radar Equation:**						**9**
Introduction- Basic radar –The simple form of the Radar equation- Radar block diagram-Applications of radar — Detection of signals in noise- Receiver noise and the signal-to-noise ratio-Probability density functions- Probabilities of detection and False alarm-Integration of radar pulses - Transmitter power - Pulse repetition frequency							
Unit– II	**MTI and Pulse Doppler Radar:**						**9**
Introduction to Doppler and MTI radar–Delay line cancelers—Staggered PRF-Doppler filter banks-Moving target detector–Limitations to MTI performance—Pulse doppler radar							
Unit– III	**Tracking Radar:**						**9**
Tracking with radar–Monopulse tracking–Conical scan and sequential lobing–Limitations to tracking accuracy –Low-angle tracking—Tracking in range–Comparison of trackers							
Unit– IV	**Detection of Signals in Noise and Radar Waveform Design**						**9**
Detection criteria–Detectors–-Automatic detection–Integrators–Constant-False-Alarm rate receivers–The radar operator–signal management - Theoretical accuracy of radar measurements–Time delay accuracy of frequency and radial velocity							
Unit– V	**Phased Array and Navigational Aids:**						**9**
Phased Arrays—Basic concepts, feeds, phase shifters, frequency scan arrays, applications, advantages and limitations. Navigational Aids: VOR,ILS and LORAN							
							Total:45
TEXTBOOK:							
1.	M.I.Skolnik, Introduction to Radar Systems, McGraw Hill, New Delhi,44th Reprint,2018, for Units I, II, III, IV.						
2.	G.S.N.Raju, Radar Engineering and Fundamentals of Navigational Aids, I.K. International, New Delhi,2019, for Unit V.						
REFERENCES:							
1.	Gottapu Sasi Bhushana Rao, Microwave and Radar Engineering, Pearson Education,Chennai,1st Edition,2014.						

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the principles of radar	Understanding(K2)
CO2	illustrate the working of pulse Doppler radar and MTI radar	Understanding(K2)
CO3	compare the various types of tracking radar	Understanding(K2)
CO4	infer methods of detecting signals in noise	Understanding(K2)
CO5	relate the principles of radar in phased array and navigational aids	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2				2				2	2	3
CO2	3											2		3
CO3	3		2									2		
CO4	3		2	2								2		
CO5	3		2	2		2	2	2			1	2	2	3

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN -THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	15	85	-	-	-	-	100
CAT 2	15	85	-	-	-	-	100
CAT 3	15	85	-	-	-	-	100
ESE	15	85	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE22 - AUTOMOTIVE ELECTRONIC SYSTEMS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the concepts of automotive systems and apply the various novel methods to develop electronic based automobile devices for all vehicle conditions	
Unit – I	**Introduction**	**9**
Evolution of electronics in automobiles – Risk assessment and reduction - Introduction to Euro Emission standards (Ito VI) – Equivalent Bharat Standards - Working principle and characteristics of sensors: Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, Knock Sensor, Manifold Pressure Sensors, EGR sensor - Working principle and characteristics of Actuators: Solenoid Actuators –EGR actuators, Stepper motor actuator and vacuum operated actuator - Emission testing – Exhaust gas measurement – Exhaust Analyzer -Emission limits.		
Unit – II	**Charging and Starting systems**	**9**
Charging system: Requirements of the charging system – Principles – Alternators - Smart charging. Staring system: Requirements of starting system – Starter motors and circuits – Types of starter motors.		
Unit – III	**Ignition and Injection Systems**	**9**
Ignition systems: Ignition fundamentals – Electronic ignition systems – Electronic spark ignition – Distribution less Ignition - Coil on plug (COP) ignition - Spark Plugs - Electronic fuel Control : Combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Fuel Injection: Petrol fuel injection – Diesel fuel injection.		
Unit – IV	**Engine and Emission Control Systems**	**9**
Engine and Emission Control Systems: Control modes for Ignition and fuel control – Engine management system - Catalytic converter – EGR – SCR – DeNox Trap - Diagnostics systems in modern automobiles - In vehicle networks: CAN, LIN, FLEXRAY, MOST.		
Unit – V	**Chassis, Comfort and Safety Systems**	**9**
Antilock braking system - Traction and Stability Control – Active Suspension – Electronic control of automatic transmission – Cruise control – Adaptive cruise control – Airbag and Seat belt tensioners - Centralized door locking system – Obstacle avoidance Radar – Automatic Parking System - Electric vehicles.		
		Total:45

TEXT BOOK:

1.	Tom Denton, "Automobile Electrical and Electronics Systems", 5th Edition, Edward Arnold Publishers, London, 2018.

REFERENCES:

1.	Hollembeak & Barry, "Automotive Electricity, Electronics & Computer Controls", 1st Edition, Delmar Publishers, New York, 1998.
2.	Tim & Gilles, "Automotive Engines: Diagnosis, Repair, Rebuilding", 8thEdition, Delmar Publishers, New York, 2017.
3.	Ribbens William B., “Understanding Automotive Electronics”, 8thEdition,Butterworth- Heinemann Publishers, Burlington,2017

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the continuous changes in emission norms of India and uses of electronic devices in automobile applications.	Understanding (K2)
CO2	describe the operations of charging and starting techniques involved in Vehicles.	Understanding (K2)
CO3	utilize the principles of electronic ignition and fuel injection system used in automobile.	Understanding (K2)
CO4	apply the engine and fuel control system for ECU used in engine management system.	Applying (K3)
CO5	employ the essential comfort and safety systems for automobile.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			2	3	3	3				2	2	
CO2	2				2							2	2	
CO3	3		2	2	3		2					2	2	
CO4	3	2	2	2	3	2	2					2	2	
CO5	3	2	2	2	3	3	2	3				3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE23 - WIRELESS SENSOR NETWORKS							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge on MAC layer and PHY layer functionalities, routing, mobility and synchronization.	
Unit– I	**IEEE802.15.4 PHY layer**	**9**
Introduction - Types of Wireless Sensor Networks - Hardware components - Power consumption - Memory management network topologies - Sensor network Communication stack - Superframe structure - Data transfer model - Frame structure- IEEE 802.15.4phy: Frequency range - Channel assignments -Minimum LIFS and SIFS periods- Contiki OS - Overview		
Unit– II	**Medium Access Protocol**	**9**
MAC functional description - MAC frame formats and MAC command frames - Design criteria for Medium Access Protocols - Time Division Multiple Access - Carrier Sense Multiple Access -Sensor MAC- Berkeley MAC - Optimizations of B-MAC		
Unit– III	**Wireless Link Estimation Protocols**	**9**
Introduction - Links and geographic distance - Asymmetric links - Link stability and burstiness, Naming and addressing - Assignment of addresses and names - Link estimation protocols - Link quality based protocol - Delivery rate based protocol - Collection tree protocol		
Unit– IV	**Routing and Data Aggregation**	**9**
Routing basics - Full-network broadcast - Location-based routing directed diffusion Collection tree protocol - Clustering techniques random clustering - Nearest sink - Geographic clustering -In-network processing and Data aggregation-compression-Statistical techniques.		
Unit– V	**Localization and Synchronization**	**9**
Time synchronization-Clocks and delay sources -Lightweight tree synchronization- Reference broadcast synchronization- No ime protocol - Localization challenges and properties - Types of location information - Pre-deployment schemes- Proximity schemes - Ranging schemes-Triangulation-Trilateration - Range-based localization - Range-free localization -Hop-based localization - Point in Triangle(PIT)		
		Total:45

TEXTBOOK:

1.	Anna Förster, "Introduction to Wireless Sensor Networks",1st Edition, IEEE-Wiley Press,NewJersey,2016.

REFERENCES:

1.	IEEE Standard for Local and metropolitan area networks, Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs), IEEE Computer Society, New York, 2011.
2.	T.Winter,Ed., P.Thubert, Ed., A. Brandt, J.Hui, R. Kelsey, P.Levis, K.Pister, R.Struik, JP.Vasseur and R.Alexander,"RFC6550: RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks", 2012.
3.	FadiAl-Turjman, "Wireless Sensor Networks Deployment Strategies for Outdoor Monitoriing",1st Edition, CRC Press, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the physical layer functionalities of IEEE 802.15.4 sensor devices	Understanding(K2)
CO2	apply MAC frame modeling of IEEE802.15.4 sensor devices	Applying(K3)
CO3	identify suitable link estimation protocols for WSN topology management.	Applying(K3)
CO4	apply routing and data aggregation mechanism of sensor nodes.	Applying(K3)
CO5	interpret the localization and synchronization functionalities of IEEE 802.15.4 sensor devices	Understanding(K2)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1										2	1
CO2	3	2	1									1	3	2
CO3	3	3	2	2	1			2	2		2	2	3	2
CO4	3	2	1	1				2				1	3	2
CO5	2	1									2		3	1

1–Slight,2–Moderate,3–Substantial, BT-Bloom’s Taxonomy

ASSESSMENTPATTERN- THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	10	45	45	-	-	-	100
CAT3	10	45	45	-	-	-	100
ESE	10	50	40	-	-	-	100

*±3% may be varied (CAT 1,2,3 – 50 marks & ESE–100 marks)

22ECE24- INDUSTRY 4.0							
Programme & Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Microprocessor and Microcontroller	7	PE	3	0	0	3

Preamble	To acquire the fundamentals of industry 4.0 -IIoT revolutions, technology and its business use case and identify applications of Sensors for industry 4.0	
Unit – I	**Introduction to Industry 4.0 and Industrial Internet of Things**	**9**
Introduction - Industry 4.0 – IIoT (Industrial Internet of Things) Industry 4.0: Introduction - Design requirements and drivers of Industry 4.0 - Sustainability assessment of industries - Smart business perspective – Cyber security - Impacts of Industry 4.0.		
Unit – II	**Industrial IoT and Reference Architecture:**	**9**
IIoT and Industry 4.0 – IIC - Industrial internet systems - Industrial sensing -Industrial processes. Business models: Introduction – Definition – Business models of IoT and IIoT – Reference architecture of IoT and IIoT -IIRA -Key performance indicators and occupational safety and health.		
Unit – III	**Off-Site and On-Site Key Technologies**	**9**
Off-site Technologies: Introduction - Cloud computing – Fog computing. On-site technologies: Introduction - Augmented reality - Virtual reality - Big data and advanced analytics - Smart factories - Lean manufacturing system.		
Unit – IV	**Industrial Data Acquisition Systems**	**9**
Sensors: Introduction – characteristics – categories. Actuators: Thermal, Hydraulic, Pneumatic, Electromechanical actuators - Industrial data transmission: Fieldbus – Profibus –HART – Modbus – CAN – DeviceNet – LoRA – NB-IoT - Distributed control system – PLC - SCADA.		
Unit – V	**Industrial IoT Analytics and Case Study**	**9**
Necessity of analytics -Categorization of analytics – Usefulness and challenges of analytics - Mapping and deployment of analytics -Artificial intelligence- Applications of analytics across value chain -Plant security - Case study: Inventory management and quality control - Manufacturing industry		
		Total:45

TEXT BOOK:

1.	Sudip Misra, Chandana Roy, Anandarup Mukherjee, “Introduction to Industrial Internet of Things and Industry 4.0”, 1st Edition, CRC Press, USA, 2021.

REFERENCES:

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 1st Edition, APress; 2016.
2.	Alp Ustundag, EmreCevikcan , “Industry 4.0: Managing the Digital Transformation”, 1st Edition, Springer International Publishing AG, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summaries the concepts and business opportunities of Industry 4.0	Understanding (K2)
CO2	explain the role of IoT and IIoT architecture for Industry 4.0	Understanding (K2)
CO3	outline applications of various recent technologies in the implementation of Industry 4.0	Understanding (K2)
CO4	identity the applications of sensors, actuator and modern embedded bus technologies	Applying (K3)
CO5	utilize the importance of IIoT analytics for various use cases	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2					2						2	2
CO2	2	2	2	2									2	2
CO3	3	2	3		3	2				2	2		2	2
CO4	3	3	3	2	2	2	2			2	2		2	2
CO5	2	3	2	3	2	2	2			2			2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
CAT3	20	50	30	-	-	-	100
ESE	20	50	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE25-TESTING AND FAULT DIAGNOSIS OF VLSI CIRCUITS							
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**VLSI Design**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To infer the process of test generation, Design For Testability (DFT) architecture and fault diagnosis	
Unit – I	**Fault Modeling and Simulation:**	**9**
Defect, errors and faults - Functional versus structural testing - Levels of fault models - Single stuck-at fault - Modeling circuits for simulation - Algorithms for true-value simulation - Algorithms for fault simulation - Statistical methods for fault simulation		
Unit – II	**Test Generation for Combinational Circuits:**	**9**
Algorithms and representation - Redundancy identification - Testing as a global problem - Combinational ATPG algorithm: D-algorithm – PODEM and FAN algorithm - Test generation systems -Test compaction.		
Unit – III	**Test Generation for Sequential Circuits:**	**9**
ATPG for single clock synchronous circuits - Time-Frame expansion method - Simulation based sequential circuit ATPG		
Unit – IV	**Design for Testability (DFT):**	**9**
Testability –AdHoc design for testability techniques - Controllability and observability by means of scan registers - Generic scan based design - Classical scan designs - Board level and system level DFT approaches - Boundary scan standards		
Unit – V	**Logic - level Diagnosis:**	**9**
Basic concepts - Fault dictionary – Guided - probe testing - Diagnosis by UUT reduction-Fault diagnosis for combinational circuits - Expert systems for diagnosis - Effect cause analysis - Diagnostic reasoning based on structure and behaviour.		
		Total :45

TEXT BOOK:

1.	Bushnell M.L. and Agrawal V.D., "Essentials of Electronic Testing for Digital, Memory and Mixed- Signal VLSI Circuits", Kluwer Academic Publishers, 2nd Edition, 2004, for Units I, II, III.
2.	Abramovici, M., Breuer, M.A and Friedman, A.D., "Digital Systems Testing and Testable Design", Jaico Publishing House, 13th Impression, 2012, for Units IV, V.

REFERENCES:

1.	Laung Terngwang, Cheng wen wu, Xidogingwen, "VLSI Testing Principles and Architectures: Design for Testability", Morgan Kaufmann Publisher, 2nd Reprint, 2013.
2.	Santanu Chattopadhyay, "Thermal-Aware Testing of Digital VLSI Circuits and Systems", CRC Press, 1st Edition, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the types of fault models and simulation approaches	Understanding (K2)
CO2	generate test patterns to detect the fault in combinational circuits	Applying (K3)
CO3	understand the generation of test patterns to detect the fault in sequential circuits	Understanding (K2)
CO4	infer the concepts of Design for testability	Understanding (K2)
CO5	infer the measures of system diagnosability	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**	**2**									**2**	**2**	**2**
CO2	**3**	**3**	**2**									**2**	**2**	**2**
CO3	**3**	**3**	**2**									**2**	**2**	**2**
CO4	**3**	**3**	**2**									**2**	**2**	**2**
CO5	**3**	**3**	**2**									**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	65	15	-	-	-	100
CAT2	15	65	15	-	-	-	100
CAT3	10	90	-	-	-	-	100
ESE	10	75	15	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE26- MEMS DESIGN							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**VLSI DESIGN**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the concepts of standard MEMS and apply the knowledge of micro fabrication techniques for the design and manufacturing of a MEMS device.	
Unit – I	**Materials for MEMS and Scaling Laws:**	**9**
Microsystems and microelectronics - Working principle– Si substrate - Silicon compounds - Gallium arsenide -Quartz-piezoelectric crystals. Scaling laws - Scaling in geometry - Scaling in electrostatic forces - Scaling in electromagnetic forces - Scaling in electricity - Scaling in heat transfer		
Unit – II	**Micro Actuators and Micro Sensors:**	**9**
Micro actuation techniques- Micro actuators – Micro sensors - Micro motors – Micro pump -Micro valves – Micro grippers – Micro accelerometer – Principles, Design rules, modeling and simulation - Verification and testing.		
Unit – III	**Basic Mechanics for Micro System Design:**	**9**
Static bending of thin plates - Mechanical vibration - Thermo mechanics - Thermal stresses - Fracture mechanics -Stress intensity factors - Fracture toughness and interfacial fracture mechanics.		
Unit – IV	**Fabrication Process and Micromachining:**	**9**
Single crystal silicon wafer formation - Photolithography - Ion implantation - Diffusion – Oxidation – CVD – Physical vapor deposition - Epitaxial growth - Etching - Bulk Micro manufacturing - Surface micro machining – LIGA –SLIGA.		
Unit – V	**Micro System Design, Packaging and Applications:**	**9**
Micro System Design considerations - Process design - Mechanical design – Mask layout design - Micro system packaging – Die level - Device level - System level – Packaging techniques - Die preparation - Surface bonding -Wire bonding – Sealing - Applications of micro system in Automotive - Aero space – Telecommunications - RF MEMS		
		Total:45

TEXT BOOK:

1.	Tai-Ran Hsu, “MEMS and Microsystems Design, Manufacture, and Nano scale Engineering”, 2nd Edition, John Wiley& sons, India, 2008.

REFERENCES:

1.	Mohamed Gad-el-Hak, “The MEMS Hand book”, 2nd Edition, CRC press, 2006.
2.	M.-H. Bao, “Micromechanical Transducers: Pressure Sensors, Accelerometers, and Gyroscopes”, 1st Edition, Elsevier, New York, 2004.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain MEMS concepts and scaling laws	Understanding(K2)
CO2	design Micro sensors and actuators	Applying (K3)
CO3	infer knowledge about mechanics	Understanding(K2)
CO4	utilize micro fabrication and micro manufacturing techniques for designing MEMS	Applying (K3)
CO5	apply the knowledge of layout and packaging techniques to design a micro system	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3								2	3	
CO2	3	3	3	3	3							3	3	
CO3	3	2	2	3										
CO4	3	3	3	3	3							3	3	
CO5	3	2	3	3	3							3	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	20	60	20	-	-	-	100
CAT3	25	40	35	-	-	-	100
ESE	10	50	40	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE27- SOFTWARE QUALITY ASSURANCE AND TESTING

Programme & Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the concepts and apply the skills needed for software quality assurance and testing.	
Unit – I	**Software Quality Assurance and Review Techniques:**	**9**
Defining Quality –Need for quality –Quality control Vs Quality assurance –Quality assurance at each phase of SDLC - Need for SQA group in an Organization. Structured walkthroughs –Inspections –Various roles and responsibilities involved in Reviews / Inspections –Some psychological aspects of reviews.		
Unit – II	**Software Measurement and Metrics:**	**9**
Product quality –Models for software product Quality –Process Quality. Measurement and Metrics: Introduction –Measurement during software life cycle context –Defect metrics –Metrics for software maintenance –Classification of software metrics — Requirements related metrics –Measurements and process improvement –Measurement principles		
Unit – III	**Basics of Testing:**	**9**
Introduction- Definition- Need for Testing- Testing Approaches-Essentials, features and principles of software Testing. Testing Environment: Assessing Capabilities, Staff Competency, and User Satisfaction-Creating an environment supportive of software testing -Building the software testing process — Testing Guidelines.		
Unit – IV	**Basics of Software Testing process:**	**9**
Overview -The Seven Step Software Testing Process - Organizing for testing-Workbench-Procedure, Developing the test plan-Workbench-Procedure, Verification testing-Workbench-Procedure -Validation testing-Workbench-Procedure.		
Unit – V	**Software Testing process:**	**9**
Analyzing and reporting test results-Workbench-Procedure, Testing software system security-Testing client/server systems-Testing web-based systems - Using Agile Methods to Improve Software Testing.		
		Total:45

TEXT BOOK:

1.	Nina S. Godbole, "Software Quality Assurance Principles and Practice", 2nd Edition, Narosa Publishing House, New Delhi, 2017 for Units I, II.
2.	Perry William, "Effective Methods for Software Testing", 3rd Edition, Wiley, New Delhi,2006, for Units III, IV, V.

REFERENCES:

1.	Mordechai Ben-Menachem & Garry S. Marliss, "Software Quality", 2nd Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2014.
2.	Limaye M.G, "Software Testing -Principles, Techniques and Tools", 1st Edition, Tata McGraw-Hill, New Delhi, 2009.
3.	RajaniRenu & Oak Pradeep, "Software Testing Effective Methods: Tools and Techniques", 2nd Edition, Tata McGraw-Hill, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the components of software quality assurance systems	Understanding (K2)
CO2	apply the concepts, metrics, and models in software quality assurance	Applying (K3)
CO3	interpret the step by step activities and set up environment for software testing	Understanding(K3)
CO4	develop procedures and workbenches for various testing process.	Applying (K3)
CO5	apply testing for client server, web based and software security systems and identify the agile methods for improving the testing process.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3	2	2	2				2					2	2
CO3	3	2	2		3			2				2	2	2
CO4	3	2	2	2	2			2			2	2	2	2
CO5	3	2	2	2	2			2			2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	65	25	-	-	-	100
CAT2	10	65	25	-	-	-	100
CAT3	10	55	35	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEE01 - FUNDAMENTALS OF RESEARCH								
(Common to All BE/BTech branches)								
Programme & Branch	**All BE/BTech branches**		**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**		**7**	**GE**	**3**	**0**	**0**	**3**
Preamble	This course familiarizes the fundamental concepts/techniques adopted in research, problem formulation and also disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.							
Unit – I	**Introduction to Research**							**9**
Introduction to Research: Types and Process of Research - Outcomes of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords.								
Unit – II	**Literature Review**							**9**
Literature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.								
Unit – III	**Research Methodology**							**9**
Research Methodology: Appropriate Choice of Algorithms/Methodologies/Methods – Data Collection – Primary Data Analysis – Experimental Methods and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations.								
Unit – IV	**Journals and Papers**							**9**
Journals and Papers: Journals in Science/Engineering - Indexing and Impact factor of Journals. Plagiarism and Research Ethics. Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study.								
Unit – V	**Reports and Presentations**							**9**
How to Write a Report - Language and Style - Format of Project Report - Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc - Different Reference Formats. Presentation using PPTs. Research Tools.								
								Total:45

TEXT BOOK:	
1.	Walliman, Nicholas. “Research Methods: The basics”. 2nd edition, Routledge, 2017., for Units I, II, III, IV & V

REFERENCES:	
1.	Mishra, S.B. and Alok, S. “Handbook of research methodology” Educreation Publishing, 2017
2.	Kumar, Ranjit. “Research Methodology: A step-by-step guide for beginners”. SAGE Publications Limited, 2019.
3.	Nayak, J.K. and Singh, P. “Fundamentals of Research Methodology Problems and Prospects”. SSDN Publishers & Distributors, 2021.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	list the various stages in research and categorize the quality of journals	Applying (K3)
CO2	formulate a research problem from published literature/journal papers	Evaluating (K5)
CO3	write, present a journal paper/ project report in proper format	Creating (K6)
CO4	select suitable journal and submit a research paper	Applying (K3)
CO5	compile a research report and the presentation	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	3	3	1	1	3	3	3
CO2	3	3	3	3	2	1	1	3	3	3	3	3	3	3
CO3	3	3	3	3	3	1	1	3	3	3	1	3	3	3
CO4	3	2	1	1	2	1	1	3	2	1	1	3	3	3
CO5	3	3	2	2	3	1	1	3	3	3	1	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		40	50	10			100
CAT2		30	50	10	10		100
CAT3		20	30	30	10	10	100
ESE		40	40	10	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE28- SOFTWARE DEFINED RADIO							
Programme &Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Analog and Digital Communication**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide an insight regarding the functioning of different blocks, techniques associated with software defined radio architecture and its flexible transmitters.	
Unit– I	**Introduction to Software Defined Radio:**	**9**
Software defined radio- Requirement for Software Defined Radio (SDR) - Benefits of multi-standard terminals - Operational requirements - Business models for SDR - Smart antenna systems.		
Unit– II	**Architecture of a Software Defined Radio:**	**9**
Software defined radio architectures - Hardware specifications - Digital aspects of software defined radio - Current technology limitations - Impact of Superconducting Technologies on future SDR Systems		
Unit– III	**Flexible RF Receiver Architectures:**	**9**
Flexible RF receiver architecture options: Single carrier and multi-carrier designs-Implementation of a digital receiver: Frequency conversion using under sampling - Achieving processing gain using oversampling - Elimination of receiver spurious products - Noise figure - Receiver sensitivity - ADC spurious signals.		
Unit– IV	**Multi-Band and General Coverage Systems:**	**9**
Multiband Flexible receiver design - RF Transmit/receive switch Image rejection mixing - Dynamic range enhancement - Feed forward techniques - cascaded non-linearity techniques		
Unit– V	**Flexible Transmitters and PAs:**	**9**
Flexible transmitters - Power amplifiers - Analog quadrature upconversion - Interpolated bandpass upconversion - PLL based modulator transmitter - All pass filtering - Polyphase filtering		
		Total:45

TEXT BOOK:

1. P Kenington, “RF and Baseband Techniques for Software Defined Radio”, Artec House, 2005.

REFERENCES:

1. Wally H. W. Tuttle bee, “Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations”, John Wiley & sons,2003
2. Jouko Vanakka, “Digital Synthesizers and Transmitter for Software Radio”,Springer,2005

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain about software defined radio architectures for performance optimization.	Understanding(K2)
CO2	identify the requirements, benefits, and different architectural models for software defined radio	Understanding(K2)
CO3	construct the functioning of different blocks and techniques associated with flexible RF receiver for SDR	Applying(K3)
CO4	comprehend the design techniques for multi-band and general coverage systems	Understanding(K2)
CO5	relate the methodologies used for flexible transmitter and PA design	Understanding(K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2		2	2						
CO2	3	2	2		3		2	2						
CO3	3	2	2		2		2	2	2	2			3	2
CO4	3	2	2		2									
CO5	3	2	2		2		2	2	2	2				3

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN -THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	60	20	-	-	-	100
CAT3	15	85	-	-	-	-	100
ESE	20	65	15	-	-	-	100

*±3% may be varied (CAT1,2,3–50 marks & ESE–100marks)

22ECE29-RF COMMUNICATIONS

Programme &Branch	B.E & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Analog and Digital Communication**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To study the RF System transceiver architecture and understand the concepts of Low Noise Amplifiers, Phase Locked Loop, Oscillators and Mixers.

Unit – I **Transceiver Specifications And Architectures:** **9**

Receiver: Single conversion receiver – Upconversion – Dual conversion – Image reject –Direct conversion – Transmitter: Super heterodyne - Direct upconversion–Transmitter with offset frequency synthesizer- Concepts of Transceiver specifications: THD - IP2 - IP3 – Sensitivity – SFDR - Noise: Thermal, shot, flicker, popcorn noise

Unit – II **Components and Amplifiers:** **9**

Passive IC components characteristics - OC time constants in bandwidth estimation and enhancement - High frequency amplifier design: Shunt – Series amplifier

Unit – III **Low Noise Amplifier Design:** **9**

LNA topologies –Design examples of Low Noise Amplifiers (LNA) – Single ended and differential LNAs-Terminated with resistors and source degeneration LNAs

Unit – IV **PLL and Frequency Synthesizers:** **9**

PLL: Linearised Model – Noise properties - Phase detectors – Loop filters and charge pumps - Sequential phase detectors - Frequency synthesizers - Integer-N frequency synthesizers

Unit – V **Mixers and Oscillators:** **9**

Mixer: Characteristics –– Non-linear based mixers- Multiplier based mixers - Single balanced and active double balanced mixers-Subsampling mixers - Oscillators: Colpitts oscillators-– Resonators – Tuned oscillators – Negative resistance oscillators

Total:45

TEXTBOOK:

1. Thomas H. Lee, “Design of CMOS RF Integrated Circuits”,2nd Edition, Cambridge University Press, UK,2004.

REFERENCES:

1. Razavi B, RF Microelectronics, 2ndEdition,Pearson Education, New Delhi,2011.
2. Jan Crols & Michiel Steyaert, "CMOS Wireless Transceiver Design", 1st Edition, Kluwer Academic Publications, UK, 2003.

COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	characterize and understand the RF system architecture for various applications	Understanding (K2)
CO2	characterize the performance of the circuit for bandwidth enhancement and amplifiers	Understanding (K2)
CO3	comprehend the fundamentals of Low Noise Amplifier design	Understanding (K2)
CO4	understand the characteristics of Phase Locked Loop and Frequency synthesizers	Understanding (K2)
CO5	understand the various configurations of Mixers and Oscillators	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**						**2**		**2**	**2**	**2**		
CO2	**3**	**3**	**2**	**2**				**2**				**2**	**2**	**1**
CO3	**3**											**2**	**2**	**1**
CO4	**3**	**3**	**2**									**2**	**2**	**1**
CO5	**3**	**3**	**2**									**2**	**2**	**1**

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	20	80	-	-	-	-	100
CAT 2	20	80	-	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	20	80	-	-	-	-	100

*±3% may be varied (CAT1,2,3–50 marks & ESE–100marks)

22ECE14- WEARABLE TECHNOLOGY							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**2**	**0**	**2**	**3**

Preamble	To apply the concept of wearable sensors, implantables and applications of wearable technology in disease detections.	
Unit – I	**Introduction to Wearables :**	**6**
Wearables: Fundamentals – Advancements - Roadmap for the future : The role of wearables-Data-information knowledge-value paradigm-The ecosystem enabling digital life-Attributes of wearables-Textiles and clothing: The meta-wearable-Challenges and opportunities-The future of wearables: Defining the research roadmap		
Unit – II	**From Wearables to Implantables :**	**6**
Clinical drive and technical challenges : Introduction-Wearables- Implantables-Instrumented prosthesis and monitoring of bone regeneration-Regenerative and biohybrid approaches-Packaging, biocompatibility, and biodegradable materials		
Unit – III	**Disease Detection using Wearable Sensors :**	**6**
Wearing sensors inside and outside of the human body for the early detection of diseases : Introduction - Cardiovascular diseases-Neurological diseases-Gastrointestinal diseases		
Unit – IV	**Mechanical and Chemical Sensors :**	**6**
Soft mechanical and biochemical sensors: Mechanical sensors-Biochemical sensors-Tears-Saliva-Wound and interstitial fluids (WF and IF)- Available bioanalytes in WFs and IFs - Methods of bioanalyte detection in WFs and IFs - Challenges of WF and IF-based wearable sensors		
Unit – V	**High Frequency Sensors and Applications:**	**6**
UHF epidermal sensors: Technology and applications-Introduction-Rationale of UHF epidermal antennas-Examples of UHF epidermal antenna systems and manufacturing-Applications to healthcare-Applications to occupational medicine, wellness, sports-Safety issue		

LIST OF EXPERIMENTS / EXERCISES:

1.	Design a Textile based electrodes as temperature sensors & strain sensors
2.	Design and measurement of electrical activity of heart.
3.	Design and measurement of electrical activity of brain.
4.	Design and measurement of electrical activity of muscle cells
5.	Design a Wearable body temperature sensors.
6.	Demonstrate the working of wristband for fitness tracker
7.	Design of smart shoe insole that tracks the user’s gait, step counts, and direction of motion.

Lecture:30 Practical :30 Total:60

TEXT BOOK:

1.	Sazonov, Edward, “Wearable Sensors: Fundamentals, implementation and applications”, Academic Press, 2nd Edition (Elsevier), 2020.

REFERENCES/ MANUAL / SOFTWARE:

1.	Mukhopadhyay, Subhas C., “ Wearable electronics sensors: For safe and healthy living”, Vol. 15,Springer, 2015.
2.	Subhas Chandra Mukhopadhyay, “Wearable Electronics Sensors - For Safe and Healthy Living”,Ist Edition Springer 2015
3.	M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018, for Unit V (Case Study)

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the concept of wearable technology to differentiate from conventional technologies	Understanding(K2) , Imitation (S1)
CO2	compare wearables and implantables	Understanding(K2), Manipulation (S2)
CO3	apply wearable sensors for disease detection and diagnosis	Applying(K3) , Precision (S3)
CO4	interpret the challenges in developing Mechanical and Chemical sensors	Understanding(K2) , Precision (S3)
CO5	apply wearable sensors employing High frequency	Applying(K3) , Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3		2		2		2					
CO2	3	2				2	2	2						
CO3	3		3		2	2	2	2	2			2	2	
CO4	3		3		2	2	2	2	2			2	2	
CO5	3		3	2	2	2	2	2	2	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	10	50	40	-	-	-	100
CAT3	10	50	40	-	-	-	100
ESE	10	50	40	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE30 - CYBER PHYSICAL SYSTEMS							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To explore the logical foundations of Cyber-Physical Systems organized along the dimensions like modeling, control and computational thinking.	
Unit – I	**Introduction:**	**9**
Cyber-Physical System (CPS)-structure of a cyber-physical system-Stanford testbed of autonomous rotorcraft for multi agent control (STARMAC)-The Design Process-Modelling, Design and Analysis-Applications: Heart surgery, fly-by-wire aircraft, Traffic control - Continuous Dynamics-Newtonian Mechanics- Actor Models- Properties of Systems- Feedback Control. Discrete Systems-Finite- State Machines- Extended State Machines- Non-determinism- Behaviors and Traces		
Unit – II	**Modeling Dynamic Behaviors:**	**9**
Hybrid Systems- Modal Models- Classes of Hybrid Systems. Composition of State Machines- Concurrent Composition- Hierarchical State Machines, Concurrent Models of Computation: Structure of Models- Synchronous-Reactive Models- Dataflow Models of Computation- Timed Models of Computation		
Unit – III	**Security of Cyber-Physical Systems:**	**9**
Cyber Security Requirements- Defining Security and Privacy -Attack Model -Countermeasures -System Theoretic Approaches- Examples of Security and Privacy in Action- Approaches to Secure Cyber-Physical Systems- Ongoing Security and Privacy Challenges for CPSs		
Unit – IV	**Synchronization in Distributed Cyber-Physical Systems**	**9**
Formal Software Engineering- Distributed Consensus Algorithms- Synchronous Lockstep Executions- Time-Triggered Architecture-Related Technology- Physically Asynchronous, Logically Synchronous Systems.		
Unit – V	**Real-Time Scheduling for Cyber-Physical System**s	**9**
Scheduling with Fixed Timing Parameters- Memory Effects, Multiprocessor/ Multicore Scheduling- Accommodating Variability and Uncertainty- Managing Other Resources- Rhythmic Tasks Scheduling.		
		Total:45

TEXT BOOK:

1.	E. A. Lee and S. A. Seshia "Introduction to Embedded Systems - A Cyber-Physical SystemsApproach", The MIT Press,2nd Edition, Feb, 2017, for Units I, II.
2.	Raj Rajkumar, Dionisio de Niz , Mark Klein "Cyber-Physical Systems" , Pearson Education, Inc,1st Edition,2017, for Units III, IV & V.

REFERENCES:

1.	Rajeev Alur "Principles of Cyber-Physical Systems", MIT Press Limited, 1st Edition, 2015
2.	Fei Hu, "Cyber-Physical Systems: Integrated Computing and Engineering Design", Taylor & Francis, 1st Edition, 2013

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	explain the design constraints of Cyber-Physical Systems (CPS).	Understanding (K2)
CO2	employ the functional behavior of CPS based on standard modeling	Applying (K3)
CO3	interpret the security requirements and challenges in CPS	Understanding (K2)
CO4	choose CPS requirements based on operating system and hardware architecture constraints.	Applying (K3)
CO5	apply the correctness of CPS implementations against system requirements and timing constraints	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2	3	2	2	2									2	
CO3	2					3		3					2	
CO4	3	2	2	2									2	2
CO5	3	2	2	2									3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	65	25	-	-	-	100
CAT 2	10	65	25	-	-	-	100
CAT3	10	55	35	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE31 - NANOTECHNOLOGY FOR ENERGY SUSTAINABILITY							
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge on nanotechnology, synthesis of nanomaterials, analysis and its uses in energy storage applications.	
Unit - I	**Nanoscience and Technology:**	**9**
Emerging trends in nanoscience and technology - Challenges in nanoscience and technology - Carbon age-new form of carbon (CNT to Graphene) - Quantum dots - Optical, electrical, mechanical, and magnetic properties of nanomaterials.		
Unit - II	**Synthesis of Nanomaterials:**	**9**
Top-Down and Bottom-Up approach - Chemical precipitation - Sol-gel synthesis - Microwave heating and Electro deposition – CVD – Lithography - Ball milling - Types of nanocomposite (i.e. metal oxide and polymer based).		
Unit - III	**Structural, Electrochemical Measurements and Analysis:**	**9**
FTIR analysis - X-ray diffraction - Raman spectroscopy - BET analysis - Cyclic voltammetry - Galvanostatic charge and discharge measurements - Electrochemical impedance spectroscopy.		
Unit - IV	**Renewable Energy Storage Mechanism**	**9**
Ragone plot, Batteries: Lithium ion battery - Supercapacitor: Taxonomy of supercapacitor – EDLC – Pseudocapactior - Hybrid Supercapacitor.		
Unit - V	**Applications of Nanomaterials in Energy Conversion and Storage:**	**9**
Solar cells and batteries - Fuel cells - PEM fuel cell - Acid/ alkaline fuel cells - Design of fuel cells - Carbon nanotubes for energy storage - Rechargeable batteries based on nanomaterials.		
		Total:45

TEXT BOOK:

1.	Charles P. Poole JR. & Franks. J. Qwens, "Introduction to Nanotechnology", 1st Edition, Wiley India Edition , New Delhi, 2012 for Units I, II, III.
2.	Linden, "Hand book of Batteries and fuel cells", 4th Edition, McGraw Hill, New Delhi, 2011 for Units IV,V.

REFERENCES:

1.	Mick Wilson & Kamali Kannagara, "Nanotechnology – Basics Science and Emerging Technologies", 1st Edition, Overseas Press , New Delhi, 2005.
2.	Pradeep .T, "Nano the Essential Nanoscience and Nanotechnology", 1st Edition, McGraw Hill, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the fundamentals of nanoscience and technology	Understanding (K2)
CO2	apply the methods to synthesize nanomaterials for energy storage devices	Applying (K3)
CO3	describe the structural and electrochemical analysis of nanomaterials	Understanding (K2)
CO4	summarize and the working principles of energy storage devices	Understanding (K2)
CO5	interpret the design of supercapacitor, fuel cell and batteries	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			2				1				2	
CO2	3	2	2	2	2				2	1			2	
CO3	3	2	2	2	2				2	2			2	
CO4	3	2	2	2	2				2	1			2	
CO5	3	3	3	3	3	2	2		2	2			2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	10	60	30	-	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE32 – LOW POWER VLSI DESIGN								
Programme& Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**VLSI Design**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To design digital VLSI circuits with emphasis on low power aspects.	
Unit – I	**Sources of Power Dissipation:**	**9**
Sources of power dissipation: Short-circuit power dissipation - Switching power dissipation - Glitching power dissipation - Leakage power dissipation.		
Unit – II	**Supply Voltage Scaling for Low Power:**	**9**
Device feature size scaling - Architectural-level approaches - Voltage scaling using high-level transformations - Multilevel Voltage Scaling (MVS) - Challenges in MVS - Dynamic voltage and frequency scaling - Adaptive voltage scaling - Subthreshold logic circuits		
Unit – III	**Switched Capacitance Minimization:**	**9**
System-level approach: Hardware–Software Codesign - Transmeta's crusoe processor - Bus encoding -Clock gating -Gated-Clock FSMs - FSM State Encoding - FSM Partitioning - Operand Isolation – Precomputation - Glitching power minimization - Logic Styles for low power		
Unit – IV	**Leakage Power Minimization:**	**9**
Fabrication of multiple threshold voltages - VTCMOS approach - Transistor stacking - MTCMOS approach - Power gating - Isolation strategy - State retention strategy - Power-gating controller - Power management – Dual, V_t Assignment Approach (DTCMOS) - Delay-Constrained Dual-V_t CMOS Circuits – Energy, Constrained Dual V_t CMOS Circuits - Dynamic V_{th} Scaling		
Unit – V	**Adiabatic Logic Circuits and Battery-Aware Systems:**	**9**
Adiabatic charging - Adiabatic amplification - Adiabatic logic gates -Pulsed power supply - Stepwise charging circuits - Partially adiabatic circuits - The widening battery gap - Overview of battery technologies - Battery characteristics - Principles of battery discharge - Battery modeling - Battery-driven system design		
		Total:45

TEXT BOOK:

1.	Ajit Pal, "Low-Power VLSI Circuits and Systems", 1st Edition, Springer, 2015.

REFERENCES:

1.	Dimitrios Soudris, Chirstian Pignet, Costas Goutis, "Designing CMOS Circuits for Low Power", 1st Edition, Springer, 2010.
2.	Kaushik Roy and S.C.Prasad, "Low power CMOS VLSI circuit design", Wiley, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	enumerate the sources of power dissipation in CMOS circuits	Understanding (K2)
CO2	understand the voltage scaling techniques at circuit level	Understanding (K2)
CO3	interpret the approaches for switched capacitance minimization	Understanding (K2)
CO4	outline the leakage power minimization techniques	Understanding (K2)
CO5	understand the adiabatic circuits and power management methods to optimize the battery lifetime.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2									2	3	2
CO2	3	3	2									2	3	2
CO3	3	3	2									2	3	2
CO4	3	3	2									2	3	2
CO5	3	3	2									2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85	-	-	-	-	100
CAT2	15	85	-	-	-	-	100
CAT3	15	85	-	-	-	-	100
ESE	15	85	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECE33- BRAIN COMPUTER INTERFACE AND APPLICATIONS								
Programme & Branch	**B.E & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the fundamentals, building blocks of a Brain Computer Interface and the different feature extraction techniques, classification algorithms that are used in BCI.	
Unit – I	**Introduction to BCI:**	**9**
Introduction - Brain structure and function - Brain Computer Interface (BCI) Types – Synchronous and asynchronous -Invasive BCI -Partially invasive BCI - Noninvasive BCI - Structure of BCI system - BCI monitoring hardware – EEG – ECoG – MEG - fMRI		
Unit – II	**Brain Activation:**	**9**
Brain activation patterns – Spikes - Oscillatory potential and ERD - Slow cortical potentials - Movement related potentials - Mu rhythms - Motor imagery - Stimulus related potentials -Visual evoked potentials – P300 and auditory evoked potentials - Potentials related to cognitive tasks.		
Unit – III	**Feature Extraction Methods:**	**9**
Signal Processing : Spike sorting - Frequency domain analysis - Wavelet analysis - Time domain analysis - Spatial filtering - Artifacts reduction		
Unit – IV	**Machine Learning Methods for BCI:**	**9**
Classification techniques : Binary classification, Ensemble classification, Multiclass Classification - Evaluation of classification performance - Regression : Linear, Polynomial, RBF, Gaussian processes		
Unit – V	**Applications of BCI:**	**9**
Case Studies: Tracking arm (hand) position – Controlling prosthetic devices - Cursor and robotic control using multi electrode array implant – Medical Applications: Motor Restoration, Brain control wheel chair- Non-medical applications: Monitoring alertness and entertainment - Ethics of Brain Computer Interfacing.		
		Total:45

TEXT BOOK:

1.	Jonathan Wolpaw, Elizabeth Winter Wolpaw, “Brain Computer Interfaces: Principles and practice”, 1st Edition Oxford University Press, 2012, for Units I, II.
2.	Rajesh .P.N.Rao, “Brain-Computer Interfacing: An Introduction”, 1st Edition, Cambridge University Press, 1st edition, 2013, for Units III, IV, V.

REFERENCES:

1.	Ella Hassianien, A, Azar.A.T , “Brain-Computer Interfaces Current Trends and Applications”, 1st Edition, Springer, 2015.
2.	Maureen Clerc, Laurent Bougrain, Fabien Lotte, “Brain-Computer Interfaces: Methods and Perspectives”, 1st Edition, Wiley, 2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	comprehend and appreciate the types and structure a modern BCI system.	Understanding (K2)
CO2	differentiate various brain potentials and their significance.	Understanding (K2)
CO3	choose appropriate feature extraction techniques for the BCI applications	Applying (K3)
CO4	use classification and regression techniques for the BCI signals	Applying (K3)
CO5	comprehend invasive and non-invasive class BCI applications	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											2	2
CO2	2	2											2	2
CO3	3	2	2	2								2	2	2
CO4	3	2	2	2	2							2	2	2
CO5	2	2						2				2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT2	30	50	20	-	-	-	100
CAT3	20	60	20	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECO01 - BASICS OF ELECTRONICS IN AUTOMATION APPLIANCES								
(Offered by Department of Electronics and Communication Engineering)								
Programme & Branch	**All BE/BTech Branches except Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Nil**	**5**	**OE**	**3**	**0**	**2**	**4**	

Preamble	To understand the working principles of electronics in appliances and identity the applications of sensors in electronic Device.	
Unit – I	**Introduction to Electronic Components:**	**9**
Switches – Mechanical switches – Poles and throws – Push-button switches – Resistors – Capacitors – Diodes – Transistors – Power Source – Batteries – Soldering – Safety – Applications.		
Unit – II	**Electronics and Sensors in Practice:**	**9**
Motors and controllers – Sensors – Accelerometers – Digital compasses or Magnetometers – Light and Color sensors – Infrared remote – Microwave oven – Television (TV) – Washing machine – Air Conditioner (AC) – Vacuum cleaner		
Unit – III	**Electronics in Automotive System Gadgets**:	**9**
Basics of electronic engine control: Concept of an electronic engine control system- Cruise control electronics- Antilock braking system- Electronic suspension control system - Blind spot detection- Automatic collision avoidance system		
Unit – IV	**IoT Enabled Automation System Architecture:**	**9**
Towards industrial and societal automation and digitization - Arrowhead framework architecture- Engineering of an arrowhead compatible multi domain facility - Component-based engineering methodology- Safety and security engineering of IoT automation systems. Case study: Complex system management and automation		
Unit – V	**Electronic Product Safety Standards:**	**9**
Product Safety Standards: What Is a Standard, Structure of the product safety standard - Conformity to product safety standards- Types of product safety standards- Objectives for products safety standards- product safety standard developers- Means of Protection- Constructive aspects related to EMC- Serviceability.		

EXPERIMENTS:

1.	Measurement of temperature using Thermistor
2.	Measurement of temperature using Thermocouple
3.	Measurement of torque/ Strain using Strain Gauge
4.	Speed measurement using Encoder and Opto-coupler
5.	Measurement of displacement using Potentiometer
6.	Measurement of displacement using LVDT / Capacitive transducer

Lecture: 45 Practical: 30 Total:75

TEXT BOOK:

1.	Westcott, S., & Westcott, J. R, "Basic Electronics: Theory and Practice", 3rd Edition Stylus Publishing, LLC,2020, for Units I, II.
2.	William B. Ribbens, "Understanding Automotive Electronics an Engineering Perspective", 8th Edition, Elsevier UAS,2017 , for Unit III.

REFERENCES:

1.	SteliLoznen, Constantin Bolintineanu, Jan Swart,"Electrical Product Compliance and Safety Engineering", Artech House Publishers, 1st Edition, 2017, for Unit IV
2.	BY Jerker Delsing, "IoT Automation - Arrowhead Framework", CRC Press, USA, 1st Edition 2017, for Unit V

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand basic of electronic components	Understanding(K2)
CO2	demonstrate real life electronic appliances	Understanding(K2)
CO3	conceptualize the connected device architecture	Applying(K3) / Precision(S3)
CO4	relate electronics in modern automotive	Understanding(K2) / Precision(S3)
CO5	relate the requirements of safety standard for different products	Understanding(K2) / Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	2	2								2	2		
CO2	2	2	2			2	2				2	2		
CO3	2	2	2	2		2	2	3			2	2		
CO4	2	2	2	2		2	2	3			2	2		
CO5	2	2	2	2		2	2	3			2	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	10	60	30	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	20	65	15	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECO02 – IMAGE PROCESSING							
(Offered by Department of Electronics and Communication Engineering)							
Programme & Branch	**All BE/BTech Branches except Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**0**	**2**	**4**

Preamble	This course enables the students to learn and apply the various Digital Image Processing techniques on real time images	
Unit - I	**Digital Image Fundamentals:**	**9**
Brightness– Contrast– Hue– Saturation– Mach band effect, Image sampling– Quantization, Basic relationship between pixels-Color image fundamentals – RGB– HSI models - Need for transforms - DFT-DCT- Haar Transform		
Unit - II	**Image Enhancement and Restoration:**	**9**
Image Enhancement: Basic intensity transformations – Piecewise linear transformation functions, Histogram equalization - Spatial and Frequency domain filtering: Smoothing and sharpening filters.		
Unit - III	**Image Restoration**	**9**
Image Degradation model - Noise distributions– Median – Geometric mean – Harmonic mean – Contra harmonic mean filters – Order Statistics filters – Inverse and wiener filtering – Constrained least square filtering.		
Unit - IV	**Image Segmentation, Representation and Description:**	**9**
Point, line and edge detection – Basics of intensity thresholding – Region based segmentation : Region growing – Region splitting and merging, Morphology – dilation and erosion – opening and closing		
Unit - V	**Image Compression:**	**9**
Fundamentals: Fidelity Criteria – Types of redundancy – Huffmann – Run length coding – Arithmetic coding –Block Transform Coding - Lossless and Lossy Predictive coding		

LIST OF EXPERIMENTS / EXERCISES:

	Simulation of the following Image Processing techniques:
1.	Finding DCT of an input image
2.	Image enhancement using basic intensity transformation techniques.
3.	Contrast enhancement using Histogram Equalisation
4.	Edge Detection in images using image sharpening masks
5.	Restoration of an original image by the addition of noise (Gaussian & Impulse)
6.	Morphological operation on an input image

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Rafael C Gonzalez & Richard E Woods, "Digital Image Processing", 4th Edition, Pearson Education, New Delhi, 2020

REFERENCES/ MANUAL / SOFTWARE:

1.	Jayaraman S, Esakkirajan S & Veerakumar T, "Digital Image Processing", 1st Edition, 22nd Reprint, Tata McGraw Hill, New Delhi, 2018.
2.	Alan C. Bovik, “The Essential Guide to Image Processing”, 1st Edition, Academic Press, 2009
3.	Anil K Jain, "Fundamentals of Digital Image Processing", 4th Edition, PHI Learning, New Delhi, 1995.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	demonstrate the fundamental concepts and image transforms	Applying (K3) / Precision (S3)
CO2	apply Image enhancement in both spatial and frequency domain to improve the quality of images	Applying (K3) / Precision (S3)
CO3	Use image restoration techniques to restore the original images from noisy images	Applying (K3) / Precision (S3)
CO4	identify the features and region of interest of an image using segmentation, representation and description techniques for image classification	Applying (K3) / Precision (S3)
CO5	employ image compression algorithms on digital images	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3				2	2		2		
CO2	3	2	2	2	3				2	2		2		
CO3	3	2	2	2	3				2	2		2		
CO4	3	2	2	2	3				2	2		2		
CO5	3	2	2	2					2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30	-	-	-	100
CAT2	10	60	30	-	-	-	100
CAT3	10	60	30	-	-	-	100
ESE	10	60	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECO03- PCB DESIGN AND FABRICATION							
(Offered by Department of Electronics and Communication Engineering)							
Programme & Branch	**All BE/BTech Branches except Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**0**	**2**	**4**

Preamble	To fabricate PCB boards	
Unit – I	**Introduction to PCB Designing Concepts:**	**9**
Types of components used in PCB - Types of PCBs: Single layer - Double layer and Multi-layer PCB - Flexible PCB - PCB manufacturing basics		
Unit – II	**PCB Design Considerations:**	**9**
General, Mechanical and Electrical considerations - Design rules for Analog, Digital and High frequency circuits - Electromagnetic Interference/ Compatibility (EMI/ EMC).		
Unit – III	**Design and Simulation of PCB:**	**9**
Electronic Design Automation (EDA) Tools – Single layer PCB, Two layer PCB - Circuit design and simulation - Creating footprint, Placement and routing, Generating Gerber file for single layer PCB.		
Unit – IV	**PCB Fabrication Techniques:**	**9**
Image transfer techniques - Plating techniques: Immersion, Electro less, Electroplating, Solder Mask, Etching techniques, Mechanical operations		
Unit – V	**Circuit Tracing and Testing:**	**9**
Soldering techniques - Testing PCB - Environmental concern - Case studies: Power supply, Wien-bridge oscillator.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Study of CAD for PCB Design
2.	Soldering and de-soldering the components on the PCB including SMD devices
3.	Design and Simulation of 230V AC to 5V/9V/12V DC Power Supply in CAD Tool
4.	Design, simulating, assembling and soldering of IR Sensor Module
5.	Preparation of layout from the circuit design
6.	Troubleshooting of single layer and multi-layer PCB
7.	Miniproject

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Khandpur R.S., "Printed Circuit Board: Design, Fabrication, Assembly and Testing", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2017 for Units I,II, IV,V.
2.	Laboratory Manual for Unit III.

REFERENCES/ MANUAL / SOFTWARE:

1.	Mehta S.D, "Electronic Product Design", 1st Edition, S Chand Publications, New Delhi, 2011.
2.	Clyde Coombs, "Printed Circuits Handbook", 6th Edition, McGraw Hill Professional, New Delhi, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	classify the different types of PCBs	Understanding (K2)
CO2	outline the PCB design rules and considerations	Understanding (K2)
CO3	apply the PCB design rules to develop and simulate single layer PCB	Applying (K3)/ Precision (S3)
CO4	experiment with a single layer PCB for a given circuit	Applying (K3)/ Precision (S3)
CO5	identify and rectify the faults in a PCB	Applying (K3)/ Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2												
CO3	3	2	2		3				2	2		2		
CO4	3	2	2	2	3			2	2	2		2		
CO5	3	3	2	2	3	2	2	2	2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT2	30	50	20	-	-	-	100
CAT3	20	50	30	-	-	-	100
ESE	20	50	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECO04- WEARABLE DEVICES							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches except Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**0**	**0**	**3**

Preamble	To understand the concept of wearable Sensors and its applications in various sectors	
Unit – I	**Data Acquisition and Sensor Characteristics :**	**9**
Sensors, Signals, and Systems-Sensor Classification-Units of Measurements-Sensor Characteristics: Transfer Function-Span (Full-Scale Input)- Full-Scale Output-Accuracy-Calibration-Calibration Error-Hysteresis-Nonlinearity-Saturation-Repeatability-Dead Band-Resolution-Special Properties-Output Impedance-Excitation-Dynamic Characteristics-Environmental Factors-Reliability-Application Characteristics-Uncertainty		
Unit – II	**Position, Displacement and Level Sensors :**	**9**
Potentiometric Sensors-Gravitational Sensors-Capacitive Sensors-Inductive and Magnetic Sensors-Optical Sensors-Ultrasonic Sensors-Radar Sensors-Thickness and Level Sensors		
Unit – III	**Sensors for Wearable Devices :**	**9**
Pressure Sensors-Flow Sensors- Acoustic Sensors-Humidity and Moisture Sensors-Light Detectors-Radiation Detectors-Temperature Sensors		
Unit – IV	**Chemical Sensors :**	**9**
Chemical Sensor Characteristics-Specific Difficulties-Classification of Chemical-Sensing Mechanisms-Direct Sensors-Complex Sensors-Chemical Sensors Versus Instruments		
Unit – V	**Scope of Wearable Devices:**	**9**
Role of Wearables, Attributes of Wearables, The Meta Wearables – Textiles and clothing, Social Aspects: Interpretation of Aesthetics, Adoption of Innovation, On-Body Interaction; Case Study: Smart watches, Smart glasses, fitness trackers, Wearables: Challenges and Opportunities, Future and Research Roadmap.		
		Total:45

TEXT BOOK:

1.	Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 5^{th} edition., Springer, 2016, for Units I, II, III, IV.
2.	Edward Sazonov, Michael R Neuman, “Wearable Sensors: Fundamentals, Implementation and Applications” Elsevier, 2^{nd} Edition., 2020 for Unit V.

REFERENCES:

1.	Subhas Chandra Mukhopadhyay, “Wearable Electronics Sensors - For Safe and Healthy Living”,I^{st} Edition Springer 2015
2.	A.K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai. ”,I^{st} Edition 2015
3.	Er. R.K. Rajput, “Electronic Measurements and Instrumentation”, S. Chand & Company”,I^{st} Edition 2009
4.	M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018, for Unit V (Case Study)

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the concepts of Data Acquisition and Sensor Characteristics	Understanding(K2)
CO2	discuss the concepts of various wearable Position, Displacement and Level Sensors	Understanding(K2)
CO3	acquire knowledge on Sensors for Wearable devices	Understanding(K2)
CO4	describe the different chemical sensors in wearable	Understanding(K2)
CO5	apply the usage of wearable devices as assistive devices, diagnostic devices and other modern applications	Applying(K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**													
CO2	3	2	2						2			2		
CO3	3	2	2						2			2		
CO4	3	2			2	2						2		
CO5	3	2	2	2	2	2	2		2	2	2	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
CAT3	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

2ECO05-ELECTRONIC HARDWARE AND TROUBLESHOOTING							
(Offered by Department of Electronics and Communication Engineering)							
Programme & Branch	**All BE/BTech Branches except Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**2**	**0**	**2**	**3**

Preamble	To test and troubleshoot electronic hardwares	
Unit – I	**Introduction to Electronic Hardware Troubleshooting and Failure Analysis:**	**6**
Problem Solving analysis-Circuit faults-Troubleshooting methods-Safety considerations-Testing basic components-Semiconductors-Integrated Circuits-Electron tubes-Ultra capacitors-Inductors.		
Unit – II	**Troubleshooting Industrial Controls Device:**	**6**
Electronic Test Instruments: Digital multimeter-Oscilloscope, Troubleshooting industrial controls: Fundamentals-Types of controllers-Repair and Testing procedures-Preventive maintenance.		
Unit – III	**Troubleshooting Consumer Electronic Systems:**	**6**
Electric wiring circuit repair-Lighting and control system repair-TV distribution system repair- Fiber optic communication repair-Case study: Color CRT TV monitor troubleshooting.		
Unit – IV	**Troubleshooting Digital Circuits:**	**6**
Analog and Digital circuits: Binary Code-Logic gates-Digital technologies-Voltage specifications-Troubleshooting techniques, Opens and shorts: Open circuit- Open inputs - Open outputs- Short circuit, Installation and replacement of an IC chip, Troubleshooting equipment for digital circuits.		
Unit – V	**PCB Manufacturing, Maintenance and Safety Aspects:**	**6**
Troubleshooting biomedical equipment: Electrical safety and safety equipment-Trouble shooting: ECG systems-EEG systems-Ultra sound machines-X-ray machines.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Dismantling and Assembling of electronic hardware.
2.	Troubleshooting of digital circuits
3.	Troubleshooting of Shift registers
4.	Troubleshooting of speakers and amplifiers
5.	Troubleshooting of home appliances – Radio / TV
6.	Troubleshooting of PCB of Mobile phone/Modem

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Daniel R. Tomal& Aram S. Agajanian, "Electronic Troubleshooting", 4th Edition, McGraw-Hill Education, New Delhi, 2014,

REFERENCES/ MANUAL / SOFTWARE:

1.	Khandpur .R.S, "Troubleshooting Electronic Equipment: Includes Repair And Maintenance", 2nd Edition, McGraw-Hill Education, New Delhi, 2011.
2.	Shashi Bhushan Sinha, "Handbook of Repair and Maintenance Of Domestic Electronics Appliances handbook", 1st Edition, BPB Publications, 2017.
3.	Michael Jaygeier, "How to Diagnose and Fix Everything Electronic", 2nd Edition, McGraw-Hill Education, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain troubleshooting principles for testing and point out the failures of electronic equipment.	Understanding (K2)
CO2	interpret the use of testing tools and instruments for troubleshooting electronic hardware.	Understanding (K2)
CO3	identify the faults and troubleshoot the home appliances using multimeter.	Applying (K3)/ Precision (S3)
CO4	apply troubleshooting principles for testing of digital circuits and amplifiers.	Applying (K3)/ Precision (S3)
CO5	apply troubleshooting principle of Biomedical equipment.	Applying (K3)/ Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2								2		
CO2	3	2	2	2	3		2					2		
CO3	2	1	3	2	2		2		3	2		3		
CO4	3	2	2	2	2			2	3	2		2		
CO5	2	3	3	2	3	2			3	2				

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	30	50	20	-	-	-	100
CAT3	20	40	40	-	-	-	100
ESE	20	50	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECO06- OPTICAL ENGINEERING

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches except Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers

Unit – I	Introduction To Optical Fibers :	9

Introduction-general optical fiber communication system- basic optical laws and definitions-optical modes and configurations -mode analysis for optical propagation through fibers- transverse electric and transverse magnetic modes- fiber materials-fiber fabrication techniques-fiber optic cables-classification of optical fiber

Unit – II	Transmission Characteristic Of Optical Fiber :	9

Attenuation-absorption --scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference and bandwidth-intra model dispersion-material dispersion- waveguide dispersion-polarization mode dispersion-intermodal dispersion-characteristics of single mode fiber-R-I Profile-cutoff wave length-dispersion calculation-mode field diameter.

Unit – III	Optical Sources And Detectors :	9

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns, **Detectors:** PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors.

Unit – IV	Optical Receiver and Measurements :	9

Fundamental receiver operation-preamplifiers-digital signal transmission-error sources-Front end amplifiers-digital receiver performance-probability of error.

Optical power measurement-attenuation measurement-dispersion measurement- Fiber Numerical Aperture Measurements- Fiber cut- off Wave length Measurements

Unit – V	Optical Communication Systems And Networks :	9

System design consideration Point – to –Point link design –Link power budget –rise time budget, WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton.

Total:45

TEXT BOOK:

1.	P Chakrabarti, "Optical Fiber Communication‖, McGraw Hill Education (India) Private Limited, 2016 for Units I, II, III.
2.	GredKeiser, "Optical Fiber Communication‖, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013 for Units IV, V.

REFERENCES:

1.	John M.Senior, "Optical fiber communication‖" , Pearson Education, second edition.2007.
2.	Rajiv Ramaswami, "Optical Networks", 2nd Edition, Elsevier , 2004

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	realize basic elements in optical fibers, different modes and configurations	Understanding (K2)
CO2	explain the transmission characteristics associated with dispersion and polarization techniques.	Understanding (K2)
CO3	apply optical sources and detectors with their use in optical communication system.	Applying (K3)
CO4	construct fiber optic receiver systems, measurements and coupling techniques	Applying (K3)
CO5	interpret optical communication systems and its networks.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2		2		2	2			2		
CO2	3	2	2	1		2		2				2		
CO3	2	2	3	2					2			2		
CO4	2	2	3	2					2			2		
CO5	2	2	3	2		2		2	2			2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	20	50	30	-	-	-	100
CAT3	20	40	40	-	-	-	100
ESE	20	50	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MAO01 - MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING

Programme & Branch	All Engineering and Technology branches except AIDS & AIML	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	To impart the basic knowledge in linear algebra, decomposition of matrices, continuous optimization, linear regression and support vector machines which provide the foundations for machine learning and deep learning.	
Unit - I	**Vector Spaces:**	**9+3**
Real Vector spaces – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit - II	**Linear Transformations:**	**9+3**
Introduction – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - III	**Inner Product Spaces:**	**9+3**
Norms – Inner products – Length and Distance – Angle and Orthogonality – Orthonormal Basis – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection.		
Unit - IV	**Matrix Decomposition and Continuous Optimization:**	**9+3**
Matrix Decomposition: Cholesky decomposition – Singular Value Decomposition. Continuous Optimization: Introduction – Unconstrained Optimization – Gradient Descent method – Constrained Optimization – Lagrange Multipliers method – Convex Optimization.		
Unit - V	**Linear regression and Support vector machines:**	**9+3**
Linear Regression: Parameter Estimation – Maximum Likelihood estimation – Bayesian linear regression. Support Vector Machines: Introduction – Linear and Non-linear Support vector machine – Margin and support vectors – Hard and Soft margins in Support vector machines – Kernels – Primal support vector machine – Dual support vector machine.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Howard Anton and Chris Rorres, “Elementary Linear Algebra”, 11th Edition, John Wiley & Sons, New Delhi, 2014.**(Units I,II,III)**
2.	M. P. Deisenroth, A. A. Faisal, and C. S. Ong, “Mathematics for Machine Learning”, 1st Edition Cambridge University Press, 2019.**(Units IV, V)**

REFERENCES:

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2.	Ethem Alpaydin, “Introduction to Machine Learning(Adaptive Computation and Machine Learning series)”, 4th Edition, MIT Press,USA,2020.
3.	R. O. Duda, E. Hart, and D.G. Stork, "Pattern classification", 2nd Edition, John Wiley & Sons, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of vector spaces.	Understanding (K2)
CO2	apply the concepts of linear mappings in machine learning.	Applying (K3)
CO3	apply the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Applying (K3)
CO4	apply the knowledge of factorisation of matrices and optimization techniques in clustering and classification of data.	Applying (K3)
CO5	describe the concepts of parameter estimation and support vector machine.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	1												
CO3	3	2												
CO4	3	3	3											
CO5	3	2	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	20	70				100
CAT3	10	30	60				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

22MAO02 - NUMERICAL COMPUTING

Programme & Branch	Common to CSE, CSD, IT, AIDS, AIML, ECE, EEE and EIE Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To impart knowledge in interpolation, numerical differentiation and integration. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations, finding eigen values and solve linear system of equations, ordinary differential equations.	
Unit - I	**Solution to Algebraic and Transcendental Equations and Eigen value problems:**	**9+3**
Solution to Algebraic and Transcendental Equations**:** Bisection method **-** Iteration method – Method of false position – Newton-Raphson method Iterative method for Eigen values: Power method – Jacobi's method.		
Unit - II	**Solution of Simultaneous Linear Algebraic equations:**	**9+3**
Introduction - Direct methods: Gauss elimination method – Gauss - Jordan method – LU decomposition method – Crout's method –Iterative methods: Gauss Jacobi and Gauss – Seidel methods – Inverse of a matrix by Gauss Elimination method.		
Unit - III	**Interpolation:**	**9+3**
Interpolation with equal intervals: Newton's forward and backward difference formulae – Central difference interpolation formulae: Gauss forward and backward interpolation formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula.		
Unit - IV	**Numerical Differentiation and Integration:**	**9+3**
Differentiation using Newton's forward, backward and divided difference formulae – Numerical integration: Trapezoidal rule – Simpsons $1/3^{rd}$ rule – Simpsons $3/8^{th}$ rule – Double integrals using Trapezoidal and Simpson's rules.		
Unit - V	**Numerical Solution of First order Ordinary Differential Equations::**	**9+3**
Single step methods**:** Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Veerarajan T, Ramachandran T., "Numerical Methods", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.

REFERENCES:

1.	Kandasamy, P., Thilakavathy, K. and Gunavathy, K., “Numerical Methods”, Reprint Edition, S.Chand & Co, New Delhi, 2016.
2.	Sankara Rao. K., "Numerical Methods for Scientists and Engineers", 3rd Edition, Prentice Hall of India Pvt. Ltd, , New Delhi, 2007.
3.	Steven C. Chapra, Raymond P. Canale., “Numerical Methods for Engineers”, 7th Edition, McGraw-Hill Education, 2014.
4.	Sastry, S.S, "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning Pvt. Ltd, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply various numerical techniques to solve algebraic and transcendental equations.	Applying (K3)
CO2	solve simultaneous linear equations by numerical methods.	Applying (K3)
CO3	compute intermediate values of given evenly (or) unevenly spaced data.	Applying (K3)
CO4	apply the concepts of numerical differentiation and integration in real time applications.	Applying (K3)
CO5	obtain the solution of first ordinary differential equations by numerical methods.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	2	2											
CO3	3	3	2											
CO4	3	2	1											
CO5	3	3	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	15	75	-	-	-	100
CAT2	10	15	75	-	-	-	100
CAT3	10	15	75	-	-	-	100
ESE	10	15	75	-	-	-	100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

22MAO03 STOCHASTIC PROCESSES AND QUEUING THEORY

Programme & Branch	Common to CSE, IT, CSD, AIDS, AIML, EEE, EIE and MTS Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	To provide an in-depth knowledge in random variables, random process, correlation and promote the ability to apply suitable queuing models to real time applications.	
Unit - I	**Random Variables:**	**9+3**
Discrete and Continuous random variables – Probability Mass and Probability density functions – Mathematical expectation and Variance – Moments – Moment generating functions.		
Unit - II	**Random processes:**	**9+3**
General concepts and definitions – Classification – Stationary process – Markov chains – Transition probabilities – Poisson process.		
Unit - III	**Correlation and Spectral densities:**	**9+3**
Auto Correlation – Cross Correlation – Properties (Without Proof) – Power spectral density – Cross spectral density – Properties (Without Proof) – Wiener- Khintchine relation – Relationship between cross power spectrum and cross correlation function.		
Unit - IV	**Queuing Theory:**	**9+3**
Characteristics of a queueing system – Kendall's notation – Queuing model I (Infinite capacity single server Poisson queue model) (M/M/1) : (∞/FIFO) – Little's formulae – Queuing model II (Infinite capacity multiple server Poisson queue model (M/M/C): (∞/FIFO) – Queuing model III (Finite capacity single server Poisson queue model) (M/M/1): (N/FIFO) – Queueing model IV (Finite capacity multiple server Poisson model) (M/M/C) : (N/ FIFO).		
Unit - V	**Non-Markovian Queues and Queue Networks:**	**9+3**
Introduction to Non-Markovian queues – M/G/1 queue – Pollaczek-Khintchine formula – Series queues – Open and Closed queuing networks.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Veerarajan, T, "Probability and Statistics, Random Processes and Queuing Theory", 1st edition, McGraw-Hill Education, Chennai, 2019.

REFERENCES:

1.	Athanasios Papoulis, S. Unnikrishna Pillai., "Probability, Random Variables and Stochastic Processes", 4th edition, McGraw Hill, New Delhi, 2017.
2.	Allen A.O., "Probability, Statistics and Queuing Theory", 2nd Edition, Academic Press, New Delhi, 1990.
3.	Roy D. Yates and David J. Goodman, "Probability and Stochastic Processes - A friendly Introduction for Electrical and Computer Engineers", 3rd edition, John Wiley & Sons, 2014.
4.	John F. Shortle, James M. Thompson, Donald Gross and Carl M. Harris, "Fundamentals of Queuing Theory", 5th edition, John Wiley and Sons, New York, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	classify random variables and apply suitably in practical problems.	Applying (K3)
CO2	apply the concept of random process in communication problems.	Applying (K3)
CO3	understand the concepts and properties of Spectral Density Function and Cross Correlation function.	Understanding (K2)
CO4	use the appropriate queuing model for a given practical application.	Applying (K3)
CO5	identify the real time queue in computer networks and take decision accordingly.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2												
CO3	3	2												
CO4	3	3	3										2	
CO5	3	3	3										3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MAO04 STATISTICS FOR ENGINEERS AND DATA SCIENTISTS

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	To impart the basic knowledge in presentation of data, descriptive statistical measures and provide skills to apply correlation, suitable non- parametric tests and control charts to control the variations in real time applications.	
Unit - I	**Organization and Presentation of Data:**	**9+3**
Introduction to Statistics – Collection of data – Classification and tabulation of data – Types of data: primary, secondary, quantitative and qualitative data – Types of Measurements: nominal, ordinal, discrete and continuous data – Presentation of data – Diagrammatic and Graphical Representation: Histogram - Frequency curve - Frequency polygon - Cumulative frequency distributions – Ogive curves – Stem and leaf chart.		
Unit - II	**Descriptive Statistics:**	**9+3**
Measures of location or central tendency: Arithmetic mean – Median – Mode – Geometric mean – Harmonic mean – Partition values: Quartiles – Deciles and percentiles – Measures of dispersion: Mean deviation – Quartile deviation – Standard deviation – Coefficient of variation – Measures of skewness – Kurtosis.		
Unit - III	**Correlation and Regression:**	**9+3**
Correlation and Regression: Scatter Diagram – Karl Pearson's Correlation Coefficient – Rank Correlation - Regression Coefficients – Fitting of Regression Lines. **Multiple Correlation and Regression:** Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order coefficient..		
Unit - IV	**Non-parametric tests:**	**9+3**
Introduction – Sign test: One sample sign test – Sign test for paired samples – Signed rank test – Rank Sum test: Mann Whitney U test – Kruskal-Wallis test – One sample run test – Tests of randomness.		
Unit - V	**Statistical Quality Control:**	**9+3**
Introduction to Statistical quality control – Control charts – Control chart for variables: $\overline{X}$-chart – R-chart – s-chart – Charts for attributes: np-chart – p-chart – c-chart.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	S.P.Gupta, "Statistical Methods", 44th Revised Edition, Sultan Chand & Sons, New Delhi, 2011 (Units I,II, V)

2.	S.C.Gupta, V.K.Kapoor, “Fundamentals of Mathematical Statistics”, 12th Edition, Sultan Chand & Sons, New Delhi, 2022. (Units III, IV)

REFERENCES:

1.	Jay L. Devore., “Probability and Statistics for Engineering and the Sciences”, 9th Edition, Cengage Learning, USA, 2016.
2.	G.C.Beri, “Business Statistics”, 3rd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
3.	Johnson. R.A., Miller. I and Freund. J., "Miller and Freund’s Probability and Statistics for Engineers", 9th Edition, Pearson Education, India, 2018.
4.	Anthony Hayter, “Probability and Statistics for Engineers and Scientists”, 4th Edition, Cengage Learning, USA, 2012.
5.	J. K. Sharma, “Business Statistics”, 5th Edition, Vikas Publishing House Pvt Ltd, Noida, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the classification of data and present the data in various forms.	Understanding (K2)
CO2	compute and interpret descriptive statistical measures using numerical and graphical techniques.	Applying (K3)
CO3	apply statistical methods like correlation, regression analysis in analysing and interpreting experimental data.	Applying (K3)
CO4	use appropriate non-parametric test to analyze experimental data.	Applying (K3)
CO5	identify suitable control charts for monitoring processes..	Applying (K3)

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2												
CO3	3	3	2											
CO4	3	3	1											
CO5	3	3	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MAO05 - GRAPH THEORY AND ITS APPLICATIONS

Programme & Branch	**All Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	To develop rigorous logical thinking and analytical skills by graph theoretic concepts which helps for solving real time engineering problems in networks, computer architecture, compiling techniques, model checking, artificial intelligence, software engineering, expert systems, software/hardware correctness problem.	
Unit - I	**Graphs:**	**9+3**
Introduction – Definition – Types of graphs – Degree of vertex – Walk, path and cycle – Isomorphism – Connected graph – Hamiltonian graph – Euler graph – Digraph – Representations of graphs: Adjacency matrix – Incidence matrix.		
Unit - II	**Trees:**	**9+3**
Introduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – Spanning tree – Construction of spanning tree: BFS algorithm – DFS algorithm – Finding all spanning trees of a graph – Fundamental circuits.		
Unit - III	**Graph Coloring:**	**9+3**
Vertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching – Covering – Four color problem (statement only) – Simple applications.		
Unit - IV	**Network Flows and Applications:**	**9+3**
Flows and cuts in networks - Max-flow Min-cut Theorem – Transport networks –Residual capacity and Residual network – Ford-Fulkerson Algorithm – Edmonds-Karp Algorithm – Maximal Flow Applications: Multiple sources and sinks – Maximum Bipartite matching.		
Unit - V	**Graph Theoretic Algorithms:**	**9+3**
Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm – The Chinese Postman Problem – Fleury's Algorithm – Travelling salesman problem – Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Kruskal's algorithm.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", 1st Edition, Dover Publications, New York, 2016.(Units I,II,III)
2.	S. Saha Ray, "Graph Theory with Algorithms and Its Applications in Applied Science and Technology", 1st Edition, Springer, London, 2013.(Units IV,V)

REFERENCES:

1.	Douglas B West, "Introduction to Graph Theory", 2nd Edition, Pearson Education, New Delhi, 2002.
2.	Jonathan L. Gross and Jay Yellen, "Graph Theory and its Applications", 2nd Edition, CRC Press, New York, 2006.
3.	J.A.Bondy and U.S.R. Murty ,Graph Theory and Applications , 5th Edition, Elsevier Science Publishing Co., Inc., New York,1982.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand basic graph theoretic concepts.	Understanding (K2)
CO2	intrepret the concepts the concepts of tress and its types.	Applying (K3)
CO3	compute the Chromatic partition, Chromatic polynomial and Matching of a given graph.	Applying (K3)
CO4	identify the maximal flow in network by means of algorithms.	Applying (K3)
CO5	apply various graph theoretic algorithms to communication and network problems.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	1												
CO3	3	1												
CO4	3	2	2											
CO5	3	2	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

22MAX01 - DATA ANALYTICS USING R PROGRAMMING

Programme & Branch	**All Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Cre**
Prerequisites	**Nil**	**6**	**OE**	**3**	**0**	**2**	**4**

Preamble	To impart the basic knowledge in R and develop skills to apply the knowledge of R programming to statistic measures, data handling, probability, testing of hypothesis and design of experiments.	
Unit - I	**Introduction to R:**	**9**
Overview of R programming – Need for R – Installing R – Environment setup with R Studio – Packages: Installing packages Running and manipulating packages – Basic objects: Vectors – Matrix – Array – Lists – Factors – Data frames.		
Unit - II	**R Programming Structures and Functions:**	**9**
Basic expressions: Arithmetic expressions – Control Statements: if and if-else statements –– switch statement – Loops: for lo – while loop – Function: Creating a function – calling a function – Default value for function arguments – Logical functions – Ma functions – Statistical functions – Apply-family functions – Getting started with strings – Formatting data and time.		
Unit - III	**Descriptive Statistics:**	**9**
Summary command – Summarizing samples – cumulative statistics – summary statistics for data frames – summary tables Linear Modeling: Simple linear regression – Multiple regression – Curvilinear regression – Plotting linear models and curve fittir		
Unit - IV	**Working with data:**	**9**
Reading and writing data: Text-format in a file – Excel worksheets – Native data files – built-in datasets. Visualizing data: Scatt plots – line plots – bar charts – pie charts – Cleveland dot charts –Histogram and density plots – Box-whisker plots.		
Unit - V	**Probability Distributions, Testing of hypothesis and ANOVA:**	**9**
Probability Distributions: Binomial Distribution – Poisson Distribution – Normal Distribution. Testing of Hypothesis and ANOVA: Student's t-test – Non-Parametric tests: Wilcoxon U-test – Paired t and U-tests – Correlati and covariance – Tests for association – Analysis of variance: One-way ANOVA – Two-way ANOVA.		

List of Exercises / Experiments:

1.	Implementation of operations of data objects such as vector, list and matrix.
2.	Implementation and use of array, factors and data frames in R.
3.	Programs using decision making statements and looping structures.
4.	Programs to demonstrate programming concepts using functions (Using built-in and user-defined functions)
5.	Performing various basic statistical measures for the given data.
6.	Calculate the regression coefficient and obtain the lines of regression for the given data.
7.	Creating and reading various types of data files.
8.	Create different charts for visualization of given set of data.
9.	Computation of probability using Binomial, Poisson and Normal distributions.
10.	Perform the t-test for testing significance of mean.
11.	Perform various non-parametric tests for the given sample data.
12.	Perform One way and two way ANOVA.

Lecture: 45, Practical: 15, Total: 60

TEXT BOOK:

1.	Kun Ren, "Learning R Programming", 1st Edition, Packt Publishing Ltd, UK, 2016. **(Units I, II)**
2.	Mark Gardener, "Beginning R-The Statistical Programming Language",1st Edition, John Wiley & Sons,Inc, USA, 2012.**(Units III,IV, V)**

REFERENCES:

1.	Seema Acharya, "Data Analytics using R", 1st Edition, McGraw Hill Education, Chennai, 2018.
2.	Norman Matloff, "The Art of R Programming", 1st Edition, No Starch Press, San Francisco, 2011.
3.	Paul Teetor, "R Cookbook", 1st Edition, O'Reilly Media, USA, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the basics of fundamentals of R.	Understanding (K2)
CO2	apply the concepts of decision, looping structures and functions in real time problems.	Applying (K3)
CO3	apply R programming to descriptive statistics.	Applying (K3)
CO4	apply the libraries for data manipulation and data visualization in R.	Applying (K3)
CO5	use R studio to identify the probability and test statistical hypothesis.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1											
CO2	3	1	1		2									
CO3	3	2	2	2	2									
CO4	3	3	2	3	2									
CO5	3	2	2	3	2									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

22MAO06 OPERATIONS RESEARCH

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	1	0	4

Preamble	To provide the skills for solving the real time engineering problems involving linear objective functions, transportation models and also impart knowledge in finding optimal solutions to problems involving limited resources, project management techniques and game theoretic concepts.	
Unit - I	**Linear Programming:**	**9+3**
Introduction to Operations research – Applications of OR – Linear Programming – Formation of Linear Programming Problem – Solution of LPP: Basic concepts – Graphical Solution – Simplex method – Artificial techniques: Big M method.		
Unit - II	**Transportation and Assignment Problems:**	**9+3**
Transportation Problem: Introduction – Mathematical formulation – Solution of transportation problem: Initial basic feasible solution: North-West Corner Rule – Vogel's Approximation Method – Optimal Solution: MODI method. **Assignment Problems**: Introduction – Mathematical Formulation – Hungarian Algorithm.		
Unit - III	**Games Theory:**	**9+3**
Theory of Games: Introduction – Basic Terminology – Two-Person zero sum games – Pure strategies (Games with saddle point) – Mixed Strategies (Games without saddle points) – Rule of Dominance – Solution of Mixed Strategy games: Algebraic method – Arithmetic method – Graphical method.		
Unit - IV	**Sequencing models:**	**9+3**
Sequencing problems: Introduction – Johnson's algorithm – Processing of n jobs through two machines – Processing of n jobs through three machines – Processing of 'n' jobs through 'm' machines - Processing of two jobs through 'm' machines.		
Unit - V	**Network and Project Management:**	**9+3**
Introduction – Basic terminology **–** Rules of Network construction – Fulkerson's Rule for numbering of events – Construction of network – Critical Path Method (CPM) – Programme Evaluation and Review Technique (PERT).		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Sharma J.K, "Operations Research – Theory and Applications", 6th Edition, Trinity Press, India, New Delhi, 2017.

REFERENCES:

1.	Taha, Hamdy A., "Operation Research: An introduction", 9th edition, Pearson Education, 2010.
2.	Hiller, Frederick. S. and Lieberman, Gerald. J., "An introduction to Operations research- concepts and cases", Tata McGraw Hill (SIE) 8th edition, 2005.
3.	Ravindran, A., Phillips, D.J., and Solberg, J.J., "Operations Research- Principles and Practice", John Wiley & Sons, 2005.
4.	Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15th revised Edition, S. Chand & Sons Education Publications, New Delhi, 2017.
5.	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 7th Revised Edition, S.Chand and Co. Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate and solve linear programming problems.	Applying (K3)
CO2	apply transportation and assignment algorithms in engineering problems.	Applying (K3)
CO3	use game theory concepts in practical situations.	Applying (K3)
CO4	identify the minimum processing times for sequencing problems	Applying (K3)
CO5	apply the concepts of CPM and PERT in scheduling the project networks.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

22MAO07 - NUMBER THEORY AND CRYPTOGRAPHY

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	1	0	4

Preamble	To provide the skills for applying various number theoretic algorithms, congruences, primality tests in cryptography and network security and impart knowledge of basic cryptographic techniques.	
Unit - I	**Divisibility Theory:**	**9+3**
Division algorithm – Base-b representations – Number patterns – Prime and composite numbers – Fibonacci and Lucas numbers – Fermat numbers – GCD – Euclidean Algorithm – Fundamental theorem of Arithmetic – LCM.		
Unit - II	**Theory of Congruences:**	**9+3**
Basic concepts – Properties of congruences – Linear congruences – Solution of linear congruences – Fermat's Little theorem – Chinese remainder theorem.		
Unit - III	**Number Theoretic Functions:**	**9+3**
Introduction – Functions τ and σ – Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.		
Unit - IV	**Primality testing and Factorization:**	**9+3**
Primality testing: Fermat's pseudo primality test – Solvay-Strassen test – Miller-Rabin test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard's Rho method – Quadratic sieve method.		
Unit - V	**Classical Cryptographic Techniques:**	**9+3**
Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Thomas Koshy, "Elementary Number Theory with Applications", 2nd Edition, Academic Press, Elsevier, USA, 2007.(Units I,II,III)
2.	William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson Education, New Delhi, 2019.(Units IV,V)

REFERENCES:

1.	Ivan Niven, Herbert S. Zukerman, Hugh L. Montgomery, "An Introduction to the Theory of Numbers", Reprint Edition, John Wiley & Sons, New Delhi, 2008.
2.	Bernard Menezes, "Cryptography and Network Security", Cengage Learning India, 1st Edition, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of divisibility and canonical decompositions.	Understanding (K2)
CO2	obtain the knowledge in theory of congruences and solution of linear congruences.	Understanding (K2)
CO3	use different number theoretic function suitably in cryptography.	Applying (K3)
CO4	apply Primality test and factorisation algorithms to network security problems.	Applying (K3)
CO5	apply the suitable cryptographic techniques to handle real time security issues.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	1												
CO3	3	1												
CO4	3	2	1		2									
CO5	3	2	1		2									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MAO08 NON-LINEAR OPTIMIZATION

Preamble	The course focuses on the basic concepts, various techniques and applications of engineering optimization.	
Unit - I	**Classical Optimization Techniques:**	**9**
Introduction to Optimization – Statement of an Optimization problem – Mathematical formulation – Multi variable optimization with equality constraints – Lagrange multipliers method – Multi variable optimization with inequality constraint – Kuhn Tucker conditions.		
Unit - II	**Non-Linear Programming: One-Dimensional Minimization Method:**	**9**
Introduction – Unimodal function – Elimination Methods: Unrestricted search – Exhaustive search – Dichotomous search – Interval halving method – Fibonacci method – Golden section method – Direct root methods: Newton method – Secant method.		
Unit - III	**Non-Linear Programming: Unconstrained Optimization Techniques:**	**9**
Introduction to Unconstrained optimization – Direct Search Methods: Grid search method – Univariate method – Hookes and Jeeve's method – Powell's method.		
Unit - IV	**Unconstrained Optimization Techniques (Indirect Methods):**	**9**
Gradient of a Function – Indirect Search Methods: Steepest descent method – Fletcher-Reeves method – Newton's method – Marquardt method.		
Unit - V	**Non-Linear Programming: Constrained Optimization Techniques:**	**9**
Introduction – Characteristics of a Constrained Problem – Direct Methods: Random search method – Sequential linear programming – Indirect methods: Transformation techniques – Exterior penalty function method – Interior penalty function method.		

Total: 45

TEXT BOOK:

1.	S.S.Rao, Engineering Optimization Theory and Practice, 1st Edition, John Wiley & Sons Ltd, USA, 2020.

REFERENCES:

1.	David Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 4th edition, Springer-Verlag, 2015
2.	A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Engineering Optimization: Methods and applications, 2nd Edition, Wiley India Pvt. Ltd., 2006.
3.	Yang, Xin-She. Optimization Techniques and Applications with Examples. 1st Edition, John Wiley & Sons, United Kingdom, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	solve problems with equality and inequality constraints.	Applying (K3)
CO2	solve nonlinear programming problems of functions of single variable.	Applying (K3)
CO3	use methods of unconstrained optimization to solve non linear problems	Applying (K3)
CO4	solve nonlinear optimization problems in the presence of inequality and equality constraints.	Applying (K3)
CO5	apply several modern methods of optimization for solving engineering problems	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2											
CO2	3	2												
CO3	3	3	1											
CO4	3	3	3											
CO5	3	2	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	10	80				100
CAT2	10	10	80				100
CAT3	10	10	80				100
ESE	10	10	80				100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

22MAO09 OPTIMIZATION FOR ENGINEERS

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	OE	3	0	0	3

Preamble	To provide the skills for solving the real time engineering problems involving linear and non-linear objective functions and also impart knowledge in finding optimal solutions to problems involving multi-level decision making and analyzing queuing models.	
Unit - I	**Linear Programming:**	**9**
Introduction to Operations research – Applications of OR – Linear Programming – Formation of Linear Programming Problem – Solution of LPP: Basic concepts – Graphical Solution – Simplex method – Artificial techniques: Big M method.		
Unit - II	**Integer Programming:**	**9**
Introduction – Types of Integer Programming Problems – Solution of Integer programming problems – Gomory's all integer cutting plane method - Gomory's Mixed-Integer Cutting Plane Method – Branch and Bound method.		
Unit - III	**Dynamic programming:**	**9**
Introduction – Characteristics – Formulation of Dynamic programming problems –Dynamic programming Algorithm – Solution of Discrete Dynamic programming problem – Solution of LPP by Dynamic programming.		
Unit - IV	**Queueing Theory:**	**9**
Characteristics of a queueing system – Kendall‘s notation – Queuing model I (Infinite capacity single server Poisson queue model) (M/M/1) : (∞/FIFO) – Little‘s formulae – Queuing model II (Infinite capacity multiple server Poisson queue model (M/M/C): (∞/FIFO) – Queuing model III (Finite capacity single server Poisson queue model) (M/M/1): (N/FIFO) – Queueing model IV (Finite capacity multiple server Poisson model) (M/M/C) : (N/ FIFO)..		
Unit - V	**Non-Linear Programming:**	**9**
Introduction – Mathematical formulation of Non-linear programing problems – Non-linear programing problem with equality constraints – Lagrange multipliers method – Non-linear programing problem with inequality constraint – Kuhn Tucker conditions.		

Total: 45

TEXT BOOK:

1.	Sharma J.K, "Operations Research – Theory and Applications", 6th Edition, Trinity Press, India, New Delhi, 2017.

REFERENCES:

1.	Taha, Hamdy A., "Operation Research: An introduction", 9th edition, Pearson Education, 2010.
2.	Hiller, Frederick. S. and Lieberman, Gerald. J., "An introduction to Operations research- concepts and cases", Tata McGraw Hill (SIE) 8th edition, 2005.
3.	Ravindran, A., Phillips, D.J., and Solberg, J.J., "Operations Research- Principles and Practice", John Wiley & Sons, 2005.
4.	Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15th revised Edition, S. Chand & Sons Education Publications, New Delhi, 2017.
5.	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 7th Revised Edition, S.Chand and Co. Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate and solve linear programming problems.	Applying (K3)
CO2	solve Integer Programming problems that exist in real time applications.	Applying (K3)
CO3	demonstrate the theoretical workings of dynamic programming method to find shortest path for given network.	Applying (K3)
CO4	use the appropriate queuing model for a given practical application.	Applying (K3)
CO5	apply the concept of non-linear programming for solving the problems involving non-linear constraints and objectives.	Applying (K3)

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22PHO01 - THIN FILM TECHNOLOGY							
Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	This course aims to impart the essential knowledge on deposition, characterization and application of thin films in various engineering fields, and also provides motivation towards innovations.	
Unit – I	**Theories and models of thin film growth:**	**9+3**
Introduction – Theories of thin film nucleation: Impingement, Adsorption and Thermal accommodation – The capillarity model – The atomistic models – Structural consequences of thin film nucleation – The four stages of film Growth – The incorporation of defects during growth.		
Unit – II	**Vacuum technology:**	**9+3**
Principle and working of vacuum pumps: Roots vacuum pump, Rotary pump, Diffusion pump, Turbo molecular pump, Cryogenic pump, Ion pump, Ti-sublimation pump – Measurement of Pressure: Bayet-Albert gauge, Pirani and Penning gauge – Cold cathode and hot cathode ionization gauges – Pressure controlling system (qualitative).		
Unit – III	**Deposition of thin films - Physical methods:**	**9+3**
Thermal evaporation – Electron beam evaporation – Pulsed laser deposition – Ion plating – DC sputtering – RF sputtering – Magnetron sputtering – Reactive sputtering – Molecular beam epitaxy - Demonstration of deposition of thin films by RF sputtering.		
Unit – IV	**Deposition of thin films – Chemical methods:**	**9+3**
Chemical vapor deposition – Sol-gel method – Chemical bath deposition – Hydro thermal methods – Electroplating deposition – Electroless deposition – Spray Pyrolysis - Spin coating.		
Unit – V	**Characterization and Applications of thin films:**	**9+3**
Characterization: X-ray diffraction, Energy dispersive X-ray analysis, Atomic probe microscopy, Scanning Tunneling Microscope, X-ray Photoemission Spectroscopy, UV-vis spectroscopy and Four probe resistivity – Applications (qualitative): Thin film solar cells, Thin film gas sensors, Thin films for information storage and Optical coatings.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:	
1.	Maissel L.I. and Glang R, Hand book of Thin Film Technology, Reprint, McGraw Hill Inc., New York, 1970, (Unit I – IV)
2.	Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, 1st edition, CRC Press, Boca Raton, 2008 (Unit V)

REFERENCES:	
1.	Ohring M, Material Science of Thin Films, 2nd Edition, Academic Press, New Jersey, 2001
2.	Goswami A, Thin Film Fundamentals, Reprint, New Age International (P) Ltd, New Delhi, 2003
3.	Chopra K. L, Thin Film Phenomena, Illustrated, McGraw Hill Inc., New York, 1969

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	utilize the appropriate theory and models to comprehend the thin film growth process.	Applying (K3)
CO2	apply the principle of vacuum pump to explain select methods to create vacuum and to make use of the principle of vacuum gauge to explain the measurement of vacuum by select methods.	Applying (K3)
CO3	describe the deposition of thin films by select physical methods using the principle of working of respective methods.	Applying (K3)
CO4	explain the deposition of thin films by select chemical methods using the principle of working of respective methods.	Applying (K3)
CO5	make use of select characterization techniques to comprehend the properties of thin films and also to illustrate the various device applications of thin films.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	2	2						2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22PHO02- HIGH ENERGY STORAGE DEVICES

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	This course aims to impart the essential knowledge on the fundamental principles and application areas of proven technologies and materials for energy storage solutions, together with an overview of development trends in this engineering field.	
Unit – I	**Introduction to Energy Storage:**	**9+3**
An overview of energy storage systems (qualitative): Thermal energy storage, mechanical energy storage, chemical energy storage, electrical energy storage, electrochemical energy storage, electrostatic energy storage, magnetic energy storage and optical energy storage – General criteria of energy storage systems – Conventional batteries: fundamentals and applications – Grid connected and off grid energy storage systems and requirements.		
Unit – II	**Thermal storage and Mechanical Storage:**	**9+3**
Thermal storage: Thermal properties of materials, principle of operations, efficiency factors, large scale and medium scale operations – Merits and demerits of thermal storage system – Recent development in thermal storage systems. Mechanical Storage: Types of mechanical storage systems, principle of operations, emerging advances and technologies in mechanical storage systems – Flywheel.		
Unit – III	**Magnetic storage, Electro-optic, Optical and Chemical Storage:**	**9+3**
Magnetic storage: Principle of operation, emerging challenges and a review on devices and technology. Electro-optic and optical storage: Emerging devices and upcoming technologies (qualitative). Chemical storage: Power to gas – Hydrogen and Methane. Power to liquid – Bio fuels – Aluminum-Boron, silicon, and zinc.		
Unit – IV	**Electrochemical Storage:**	**9+3**
Materials, Principle of operation, positive electrode materials, negative electrode materials, electrolytes. Li-ion batteries: Principle of operation, battery components, design of electrodes, cell and battery fabrications – Building block cells – Battery modules and packs – Li-polymer batteries – Applications – Future developments: Sodium-battery, magnesium battery, aluminum battery and silicon battery.		
Unit – V	**Fuel Cells, Hydrogen storage and Super capacitors:**	**9+3**
Fuel Cells: Introduction to fuel cells, PEM (polymer electrolyte membrane), Hydrogen PEM fuel cell, direct methanol fuel cell, alkaline fuel cells and solid oxide fuel cells. Hydrogen storage systems: Solid state hydrogen storage tanks, gas phase hydrogen storage tanks, cryogenic hydrogen storage tanks and liquid phase hydrogen storage tanks. Super capacitors: Features of super capacitors, basic principle of operation, performance and technologies of super capacitors.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Robert A. Huggins, Energy Storage, Springer, 2010, (Unit I – V)
2.	Ehsani, Y. Gao, S. Gay, A. Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, New York, 2005 (Unit I - V)

REFERENCES:

1.	Yuping Wu, Lithium-Ion Batteries: Fundamentals and Applications (Electrochemical Energy Storage and Conversion), CRC Press, United Kingdom, 2015
2.	Trevor M. Letcher, Storing Energy: with Special Reference to Renewable Energy Sources, 2nd edition, Elsevier, 2022
3.	D. Linden and T. S. Reddy, Handbook of Batteries, 4th edition, McGraw Hill, Newyork, 2011

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	utilize the appropriate concepts and models to comprehend the basics of energy storage systems.	Applying (K3)
CO2	apply the principle of thermal and mechanical storage systems to explain the working and the recent advancements in thermal and mechanical storage systems.	Applying (K3)
CO3	ultilize the principle of operation of magnetic storage systems, electro-optic, optical and chemical storage systems to illustrate the respective process under gone in these techniques.	Applying (K3)
CO4	explain the principle of operation of electrochemical storage device and materials used and to elucidate the construction and working of various types of high energy storage batteries.	Applying (K3)
CO5	make use of various techniques to construct different types of fuel cells and to explain the advanced techniques involved in hydrogen storage systems and also to explain the principle and working of super capacitors.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	2	2						2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22PHO03- STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart the essential knowledge on the characterization of materials using X-ray diffraction, Raman spectroscopy, UV-visible spectroscopy, Electron microscopy and Scanning tunneling microscopy and their application in various engineering fields, and also provides motivation towards innovations.	
Unit – I	**Introduction to Characterization Techniques and X-Ray Diffraction:**	**9+3**
Importance of materials characterization – Classification of characterization techniques – Crystalline materials – Reciprocal lattice – Theory of X-ray diffraction – Powder and Single crystal X-ray diffraction: Instrumentation (qualitative), XRD pattern, systematic procedure for structure determination (qualitative), crystallite size determination (Scherrer equation), strain calculation – Applications.		
Unit – II	**Electron Microscopy:**	**9+3**
Need of electron microscopy – Electron specimen interaction: Emission of secondary electrons, backscattered electrons, characteristic X-rays, transmitted electrons, specimen interaction volume – Resolution – Scanning electron microscope and transmission electron microscope: Schematic diagram and working – Different types of filaments – Field emission scanning electron microscope –Wavelength dispersive X-ray analysis – Three parameter equation for quantitative composition analysis.		
Unit – III	**Scanning Tunneling Microscopy:**	**9+3**
Introduction to quantum mechanical tunneling – Basic principles of scanning tunneling microscopy – Two modes of scanning: constant height mode and constant voltage mode – Instrumentation and working – Applications.		
Unit – IV	**Raman Spectroscopy:**	**9+3**
Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation and working – Near-Infra-Red Raman Spectroscopy – Applications.		
Unit – V	**Ultra Violet &Visible Spectroscopy:**	**9+3**
Regions of UV-Visible radiation – Colour and light absorption – Chromophore concept – Beer's and Lambert's laws – Theory of electronic transition – Frank-Condon principle – Instrumentation and working – Applications.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Cullity B. D. and Stock S. R, Elements of X-ray diffraction, 3rd Edition, Pearson Education, India, 2003 (Unit I)
2.	Banwell C. N, McCash E. M, Choudhury H. K, Fundamentals of Molecular Spectroscopy, 5th Edition, Tata McGraw-Hill Publ., New Delhi, 2013 (Unit II-V)

REFERENCES:

1.	Holt D. B. and Joy D. C, SEM micro characterization of semiconductors, 1st Edition, Academic Press, New Delhi, 1989
2.	Willard H. H., Merritt L. L., John A Dean, and Settle Jr. F. A, Instrumental methods of Analysis 7th Edition, Wadsworth Publishing Company, United States, 1988
3.	Elton N. Kaufman, Characterization of Materials (Volume1 & 2), 2nd, Wiley-Interscience, New Jersey, 2012

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the concept of X-ray diffraction to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO2	determine the micro-structural parameters of materials and to perform surface analysis of materials using the concept of matter waves and electron microscopy.	Applying (K3)
CO3	utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image recorded at atomic level using scanning tunneling microscopy.	Applying (K3)
CO4	make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO5	apply the theory of UV-Vis spectroscopy to comprehend the working of UV-Vis spectrophotometer.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	2	2						2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	25	35	40				100
CAT3	30	30	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22PHO04 – SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL APPLICATIONS OF NANOMATERIALS

Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart the knowledge on the fundamentals of nanomaterials, synthesis of nanomaterials, analysis of nanomaterials, carbon tubes and biological applications of nanomaterials.	
Unit – I	**Introduction to nanomaterials**	**9+3**
Nanoscience and nanotechnology – Scientific revolution – Nanoscale – Nanosized effects – Surface-to-volume ratio – Quantum confinement effect – Classification of nanomaterials based on dimension – Properties of nanomaterials – Metal nanoparticles – Ceramic nanoparticles – Semiconductor nanoparticles – Polymer nanomaterials.		
Unit – II	**Synthesis of nanomaterials**	**9+3**
Physical, chemical and mechanical methods of preparation – Top down approaches and bottom up approaches – Physical Vapor Deposition method – Colloidal precipitation method – Sol-Gel method – Chemical precipitation method – Green synthesis method of nanomaterials.		
Unit – III	**Characterization of nanomaterials**	**9+3**
X-ray diffraction analysis – Grain size calculation – Lattice parameters - Cell volume – Photoluminescence analysis – Emission peak analysis – UV visible spectroscopy analysis – Bandgap estimation – HRTEM & AFM analysis (qualitative) – particle size analysis – BET (qualitative).		
Unit – IV	**Carbon nanotubes**	**9+3**
Allotropes of carbon – Diamond – Graphite – Graphene – Fullerenes – Carbon nanotubes – Properties – SWCNT – MWCNT – Structure of Carbon nanotubes – Preparation: Laser ablation method – CVD – Applications.		
Unit – V	**Biological applications**	**9+3**
Antibacterial activity – Mechanism – Antifungal activity – Microorganism – Gram positive bacteria – Gram negative bacteria – Disc diffusion method – Antioxidant activity – DPPH method – Anticancer activity – Cytotoxity – MTT method –Toxicity of nanoparticles.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Charles P Poole Jr., and Frank J. Ownes ,. “Introduction to Nanotechnology”, John Wiley Sons, Inc., 2003 (Unit I – V).

REFERENCES:

1.	C. Kittel., “Introduction to Solid State Physics”, Wiley Eastern Ltd., (2005).
2.	Tamilarasan K. and Prabu K., “Materials Science”, 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the properties of nanomaterials using concepts such as surface to volume ratio and quantum confinement and also able to classify nanomaterials.	Applying (K3)
CO2	explain the synthesis of nanomaterials using select physical and chemical methods.	Applying (K3)
CO3	explain the characterization of nanomaterials using XRD, UV-vis, HRTEM & AFM and BET.	Applying (K3)
CO4	Illustrate the preparation of CNT and their applications.	Applying (K3)
CO5	explore the biological applications of nanomaterials such as antibacterial activity, antifungal activity, antioxidant activity and anticancer activity.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	2	2						2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22PHO05 - TECHNIQUES OF CRYSTAL GROWTH

Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart the knowledge on crystals, physics of crystal growth and crystal growth methods.	
Unit – I	**Introduction to Crystals**	**9+3**
Classification of solids – Crystalline and amorphous – Single and polycrystalline materials – Space lattice – Bravais lattice – Lattice planes – Miller indices – Indices of crystal direction – Symmetry – Symmetry elements in cubic crystal – Physical properties.		
Unit – II	**Theories of Crystal Growth**	**9+3**
Phase rule – Phase diagrams – Binary phase diagrams – Alloy and compounds – Binary system with complete solid solution and no solid solution (eutectic) – Invariant reactions – Eutectic, peritectic and peritectoid (qualitative) – Nucleation concept – Homogeneous, heterogeneous nucleation – Classical theory – Energy of formation of nucleus – Kinetic theory of nucleation (qualitative) – Atmospheric nucleation.		
Unit – III	**Melt growth**	**9+3**
Bulk crystal growth methods – Melt growth methods – Bridgman (vertical and horizontal) and Czochralski methods – Liquid encapsulated technique (LEC) for semiconductors – Vermeil growth technique for growing gem crystals – Zone melting.		
Unit – IV	**Solution growth**	**9+3**
Low temperature solution growth – High temperature solution growth – Electro crystallization – Crystal growth in gel – Growth of biological crystals – Hydrothermal technique.		
Unit – V	**Vapour growth**	**9+3**
Physical vapour transport – chemical vapour transport. Epitaxial growth techniques – Liquid phase epitaxy – Vapour phase epitaxy: chloride, hydride, metalorganic – Molecular beam epitaxy – Chemical beam epitaxy.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Boardman A. D., O’Conner D. E. and Young D. A., Symmetry and its Applications in Science, London McGraw Hill, 1973. (Unit I – V)
2.	Introduction to Crystallography Philips, Read Books (9 June 2011), India. (Unit I – V)

REFERENCES:

1.	B. D. Cullity Addison, Elements of X-ray diffraction, Wesley Publishers, 1977.
2.	Santhana Raghavan and Dr. P. Ramasamy, Crystal growth processes and methods, KRU publications, 1999.
3.	Leonid V. Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Company.
4.	C. Kittel Wiley, Introduction to Solid State Physics, Eastern University Edition.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the physical properties of crystals using the concepts of crystalline materials, amorphous material, space lattice, unit cell, Miller indices and crystal symmetry.	Applying (K3)
CO2	explain nucleation in crystal growth using the concepts of phase diagrams and formation energy.	Applying (K3)
CO3	demonstrate the growth of bulk crystals using melt growth techniques.	Applying (K3)
CO4	demonstrate the growth of crystals using solution growth techniques.	Applying (K3)
CO5	comprehend the growth of epitaxy crystal using vapour growth techniques.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	2	2						2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22CYO01 - INSTRUMENTAL METHODS OF ANALYSIS								
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	Instrumental methods of analysis aim to prepare the students to have all-encompassing knowledge of spectral methods in order to identify the molecules and reaction mechanism for the process to enhance application towards the industries.

Unit – I	**Absorption and Emission Spectroscopy**	**9+3**

Basic concepts of Absorption and Emission Spectroscopy – representation of spectra – basic elements of practical spectroscopy – signal to noise ratio - techniques for signal to noise enhancement – resolving power – Fourier transform spectroscopy – evaluation of results – basic principles, instrumentation and applications of Atomic Absorption, Atomic Fluorescence and Atomic Emission Spectroscopy.

Unit – II	**IR, Raman and NMR Spectroscopy**	**9+3**

Infrared Spectroscopy – correlation of IR Spectra with molecular structure, instrumentation, samplings technique and quantitative analysis.

Raman Spectroscopy – Classical and Quantum theory instrumentation, Structural analysis and quantitative analysis.

Nuclear Magnetic resonance Spectroscopy – basic principles – pulsed Fourier transform NMR spectrometer – Structural elucidation using NMR spectra and quantitative analysis.

Unit – III	**Surface Studies**	**9+3**

Surface Study – X-Ray Emission Spectroscopy (XES), X- Ray Photo Electron Spectroscopy (XPS) - Auger Electron Spectroscopy (AES) - Transmission Electron Microscopy (TEM) - Scanning Electron Microscopy (SEM) - Surface Tunneling Microscopy (STEM) - Atomic Force Microscopy (AFM).

Unit – IV	**Mass Spectroscopy**	**9+3**

Mass spectroscopy – Ionization methods in mass spectroscopy – mass analyzer – ion collection systems - correlation of molecular spectra with molecular structure - Instrumentation design and application of Fourier Transform Mass Spectroscopy (FT-MS) and Ion Microprobe Mass Analyzer (IMMA).

Unit - V	**Thermal Analysis**	**9+3**

Thermal Analysis: principles and instrumentations and applications of Thermogravimetry (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), evolved gas detection, Thermo Mechanical Analysis and Thermometric Titration.

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Chatwal. G. R., Anand, Sham K., “Instrumental Methods of Chemical Analysis” 5th Edition, Himalaya Publishing House, 2019.

REFERENCES:

1.	B.K. Sharma, Instrumental Method of Chemical Analysis, Krishna Prakashan Media (P) Ltd. 2019.

2.	Willard,H.H, Merritt,L.L, Dean,J.A, and Settle, F.A, “Instrumental methods of analysis” CBS Publishers & Distributors, 7 Ed, 2004.
3.	Kaur. H, “Instrumental Methods of Chemical Analysis”, XII Edition, Pragati prakashan, Meerat, 2018.

COURSE OUTCOMES:

On completion of the course, the students will be able to

		BT Mapped (Highest Level)
CO1	illustrate the basics of spectroscopy to understand the instrumentation of various spectral techniques.	Understanding (K2)
CO2	apply the IR, Raman and NMR for quantitative analysis of the sample.	Applying (K3)
CO3	apply the various techniques for the better understanding of surface morphology.	Applying (K3)
CO4	explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample.	Understanding (K2)
CO5	illustrate the thermal analysis for the identification of thermal stability of the compounds.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1												
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO02 - CHEMISTRY CONCEPTS FOR COMPETITIVE EXAMINATIONS

Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to refresh the knowledge of chemistry required for competitive examinations and equip the students with a capacity to solve the problems in chemistry while participating various competitive examinations including TNFUSRC-FORESTER (paper-II: General science-chemistry), UPSC-IAS (prelims: General science-chemistry), GATE (thermodynamics concept for chemical & mechanical engineering).

Unit – I	**Periodic Classification of Elements**	**9+3**

Mendeleev's periodic table-Law and classification of elements- Modern periodic law-Modern periodic table and its characteristics - Periodic properties – important aspects of s, p & d block elements -Reactivity series and Uses - Alloys-Uses of Alloys- Properties of nano metals and oxides.

Unit – II	**Chemical Equations and Bonding**	**9+3**

Chemical Equations: Types of ions and radicals- oxidation and reduction-redox reactions - balancing ionic equations.

Chemical Bonding: Octet rule -types of chemical bond -formation of ionic and covalent bond- common properties of ionic and covalent compounds- differences between ionic and covalent compounds-Coordinate covalent bond- Coordination compounds – nomenclature and isomerism - application in analytical chemistry.

Unit – III	**Acids, Bases, Salts and Metallurgy**	**9+3**

Acid- base theory – Bronsted- Lowry theory- conjugate acid-base- Lewis concept- HSAB- applications- pH scale- Importance of pH in everyday life-salts-classification of salts-uses of salts.

Metallurgy: introduction-terminologies in metallurgy-differences between minerals and ores-occurrence of metals- metallurgy of aluminum, copper and iron.

Unit – IV	**Carbon and its Compounds**	**9+3**

Introduction-compounds of carbon-modern definition of organic chemistry- bonding in carbon and its compounds-allotropy-physical nature of carbon and its compounds-chemical properties of carbon compounds-homologous series-hydrocarbons and their types-functional groups- classification of organic compounds based on functional group-ethanol-ethanoic acid.

Unit – V	**Thermodynamics**	**9+3**

Introduction- some important terms in thermodynamics-thermodynamic system, process, properties and energy- first law of thermodynamics: mathematical expression and interpretation- applications of first law of thermodynamics-molar heat capacity-reversible isothermal expansion/compression of an ideal gas-adiabatic expansion of an ideal gas-isobaric and isochoric processes in ideal gases- second laws of thermodynamics: entropy- entropy change for isolated system (system and surroundings)- entropy change for system only (ideal gas)- entropy change for mixing of ideal gases-entropy of physical changes- entropy of chemical changes-Maxwell relations.

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Steven S. Zumdahl, Susan A. Zumdahl and Donald J. DeCoste , "Chemistry", 10^{th} Edition, Cengage Learning, 2018., for Units-I, II, III, IV.
2.	Wiley editorial board. "Wiley Engineering Chemistry". 2^{nd} Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019, for Units-I, II, III, V.

REFERENCES:

1.	B.R. Puri, L.R. Sharma, Principles of Inorganic Chemistry, 33rd Edition, Vishal Publishing Co., 2020.
2.	Paula Bruise, "Organic Chemistry", 8th Edition, Pearson Education, 2020.

COURSE OUTCOMES:

On completion of the course, the students will be able to

		BT Mapped (Highest Level)
CO1	apply the basic concept of periodic classification of elements to explain the periodic properties and reactivity series of s, p & d block elements.	Applying (K3)
CO2	utilize the concepts of chemical equation and bonding to solve the problems in balancing ionic equation and differentiate ionic and covalent compounds.	Applying (K3)
CO3	apply the concept of acid, base, salts and metallurgy to explain HSAB concepts, Importance of pH in everyday life, classification of salts and metallurgy of Al, Cu & Fe.	Applying (K3)
CO4	make use of the concept of carbon and its compounds to explain bonding and classification of carbon compounds.	Applying (K3)
CO5	utilize the important terms and concepts of thermodynamics to explain the first law and second law of thermodynamics with examples.	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO03 – ORGANIC CHEMISTRY FOR INDUSTRY							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	Organic Chemistry for Industry aims to equip the students to have wide-range knowledge on organic chemistry in order to meet the industrial needs.	
Unit – I	**Basic aspects of Organic Chemistry**	**9+3**
Organic intermediates: carbocations, carbanions, free radicals, carbenes and nitrenes, their method of formation, stability and synthetic applications- Nucleophilic uni- and bimolecular reactions (SN1 and SN2)- Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule).		
Unit – II	**Molecular Rearrangements**	**9+3**
Reactions involving electron deficient, carbon, nitrogen, oxygen centers, emphasis on synthetic utility of the rearrangements - Migration of carbon: Wagner-Meerwein, Pinacol-pinacolone, benzyl-benzilic acid rearrangement – Migration of nitrogen: Beckmann rearrangement, Hofmann, Curtius, Lossen rearrangements- Migration of oxygen: Bayer-Villiger oxidation.		
Unit – III	**Synthetic Reagents & Applications**	**9+3**
Lithium aluminium hydride- sodium borohydride- selenium-di-oxide- osmium tetroxide- phenyl isothiocyanate- N-bromosuccinamide (NBS)- lead tetraacetate - dicyclohexylcarbodiimide (DCC) – pyridinium chlorochromate (PCC) – Swern oxidation –p-toluenesulphonyl chloride – trifluoroacetic acid- lithium diisopropylamide (LDA) – 1,3- dithiane (reactive umpolung) - crown ethers-Trimethyl silyl iodide - dichlorodicyanobenzoquinone (DDQ) – Gilman reagent– phase transfer catalysts- Wilkinson's catalysts.		
Unit – IV	**Unit Operations**	**9+3**
Extraction: Liquid equilibria-extraction with reflux-extraction with agitation-counter current extraction. **Filtration:** Theory of filtration- pressure and vacuum filtration-centrifugal filtration. **Distillation:** Azeotropic and steam distillation. **Evaporation**: Types of evaporators-factors affecting evaporation. **Crystallization:** Crystallization from aqueous-non- aqueous solutions factors affecting crystallization-nucleation.		
Unit – V	**Unit Processes**	**9+3**
Nitration: Nitrating agents-aromatic nitration-kinetics and mechanism of aromatic nitration- process equipment for technical nitration-mixed acid for nitration. **Halogenation:** Kinetics of halogenations-types of halogenations-catalytic halogenations-Case study on industrial halogenation process. **Fermentation**: Aerobic and anaerobic fermentation. Production of Antibiotics: Penicillin and Streptomycin-Production of Vitamins: B2 and B12.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	P.S.Kalsi," Organic Reactions and their Mechanisms", 5th Edition, New Age International publishers, 2020, for Unit-I, II, III, V.
2.	Arun Bahl, B.S.Bahl, "Advanced Organic Chemistry", 6th Edition, S Chand, 2022, for Unit-IV, V.

REFERENCES:

1.	V.K.Ahluwalia, Rakesh Parashar, "Organic Reaction Mechanisms" Fourth Edition, 2011
2.	Jonathan Clayden, Nick Greeves, Stuart Warren, "Organic Chemistry", 2nd Edition, Oxford University Press, 2014.
3.	Paula Yurkanis Bruice, "Organic Chemistry",8th Edition, Pearson, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	illustrate the basic concept of organic intermediates to explain the SN1, SN2, E1 and E2 reactions.	Understanding (K2)
CO2	utilize the concepts of molecular rearrangement to explain reactions involving electron deficient, carbon, nitrogen, oxygen centers, emphasis on synthetic utility of the rearrangements.	Applying (K3)
CO3	select the suitable synthetic regents for various functional group conversions in organic synthesis.	Applying (K3)
CO4	make use of the concept of extraction, filtration, distillation, evaporation, crystallization for the purification of organic compounds.	Applying (K3)
CO5	apply the concept of nitration, halogenations and fermentation to explain the industrial unit process.	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO04 - CORROSION SCIENCE AND ENGINEERING							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	Corrosion science and engineering aims to equip the students to have a wide-range of knowledge on corrosion and prevention methods in order to meet the industrial needs.	
Unit – I	**Corrosion and its Units**	**9+3**
Introduction- electro chemical mechanism Vs chemical mechanism - emf series and Galvanic series – galvanic corrosion – area effect in anodic and cathodic metal coatings – prediction using emf series and galvanic series - Pilling Bedworth's ratio and it consequences (Problems) – units of corrosion rate: mdd (milligrams per square decimeter per day), mmpy (millie miles per year) and mpy (mils per year) –- importance of corrosion prevention in various industries: direct and indirect effects of determining corrosion rates - weight loss method, weight gain method and chemical analysis of solution.		
Unit – II	**Thermodynamics of Corrosion**	**9+3**
Electrode potentials, Electrical double layer, Gouy−Chapman model, Stern model, Bockris – Devanathan−Müller model - free energy and oxidation potential - criterion of corrosion (Problems) - basis of Pourbaix Diagrams - Pourbaix diagrams of water, magnesium, aluminium and Iron - limitations.		
Unit – III	**Kinetics of Corrosion**	**9+3**
Electrochemical polarization – Evan's diagram – activation polarization – concentration polarization - mixed potential theory(Wagner and Traud) – application of mixed potential theory – effect of metal in acid solution – cathodic protection of iron in acid solution – effect of cathodic reaction – effect of cathodic area – passivity – Flade potential – theories of passivity - adsorption theory – oxide film theory – film sequence theory.		
Unit – IV	**Types of Corrosion**	**9+3**
Introduction - (i) Crevice - differential aeration corrosion (ii) pitting – mechanism and factors (iii) intergranular- chromium depletion theory, weld decay and knife line attack (iv) stress - SCC mechanism and fatique- Cavitation damage – fretting damage (v) stray current corrosion - causes and its control.		
Unit - V	**Prevention of Corrosion**	**9+3**
Inhibitors – types of inhibitors, chemisorption of inhibitors, effect of concentration, effect of molecular structure, vapour phase inhibitors – prevention of corrosion at the design stage and in service conditions – control of catastrophic oxidation and hydrogen disease – Langelier saturation index and its uses - corrosion prevention by surface coatings – phosphating and its uses -principles and procedures of cathodic protection: sacrificial anodes and external cathodic current impression- painting, vitreous enamels, plastic lining.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	E. McCafferty, Introduction to Corrosion Science, 2nd Edition, Springer, 2017.

REFERENCES:

1.	R. Winston, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Revised 4th Edition, Wiley publisher, 2008.
2.	Fontanna, "Corrosion Engineering", (Materials Science and Metallurgy series), McGraw Hill international Ed., 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate the mechanism, expression of rate of corrosion and importance of corrosion studies to familiarize for industrial needs.	Understanding (K2)
CO2	demonstrate the thermodynamics and kinetics of different models of corrosion with respect to the environment.	Applying (K3)
CO3	utilize the theories of corrosion to interpret with the real time applications.	Applying (K3)
CO4	organize the various types of corrosion to understand the corrosion problems.	Applying (K3)
CO5	summarize the corrosion prevention methods to avoid corrosion related issues.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO05 - CHEMISTRY OF COSMETICS IN DAILY LIFE

Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to provide knowledge on chemistry of cosmetics for engineering students.

Unit 1	**Formulation of Cosmetic Product**	**9+3**

Introduction - basic sciences of cleansing – surfactant and adsorption, surfactant micelles, surfactants and cleansing, surfactants and foam (foam formation, stability, drainage, rupture and collapse and defoaming) - basics of dispersions - electrical charges associated with surfaces and barriers – basics of emulsion (stability, Ostwald ripening, prevention of creaming and sedimentation).

Unit 2	**Structuring Materials and Regulation for Cosmetics**	**9+3**

Introduction - water/hydrophilic base materials, oleaginous/hydrophobic base materials and amphiphilic substances - adding functions and effects - materials that add or improve functional value, emotional value and materials for quality control – cosmetic and personal care product safety – potential contaminants in cosmetics – regulations related to cosmetics – cosmetic regulation in india - future challenges in cosmetics material development.

Unit 3	**Polymers in Cosmetic Products**	**9+3**

Polymers in Cosmetics - polymer solubility and compatibility, polymer conformation - polymers that modify surfaces - film-forming polymers in cosmetics and personal care products - hair-conditioning polymers - polymers for the treatment of skin - polymers as controlled release matrices - dendritic polymers - polymeric antimicrobials and bacteriostats.

Unit 4	**Natural Products and Fragrance in Cosmetics**	**9+3**

Introduction – natural products – extraction methods - encapsulation and controlled release - allergens in cosmetics – testing for allergens - aroma chemicals - fragrance creation and duplication - fragrance applications -– malodor – fragrance allergies and sensitivities.

Unit 5	**Preparation of Cosmetics**	**9+3**

Cosmetics in day to day life – characteristics, types, formulation, preparation and evaluation methods of lipstick, shampoo, powder, nail lacquer, creams, toothpaste and hair dye.

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Kazutami Sakamoto, Robert Y. Lochhead, Howard I. Maibach, Yuji Yamashita, Cosmetic Science and Technology: Theoretical Principles and Applications, Elsevier, 2017 , for Units- I, II, III, IV, V.
2.	Gaurav Kumar Sharma, Jayesh Gadiya, Meenakshi Dhanawat A text book of cosmetic formulation, 2018, for Unit-V.

REFERENCES:

1.	R.K. Nema, K.S. Rathore , B.K. Dubey, Textbook of Cosmetics, CBS Publishers and Distributors, 2017.
2.	Bruno Burlando, Elisa Bottini-Massa, LuisellaVerotta, Laura Cornara, Herbal Principles in Cosmetics: Properties and Mechanisms of Action, CRC Press, 2010.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the formulation of cosmetics products.	Understanding (K2)
CO2	identify the structuring materials and regulation involved in cosmetics development.	Applying (K3)
CO3	interpret the polymers and its role in cosmetics.	Understanding (K2)
CO4	develop knowledge about natural products and Fragrance in Cosmetics.	Applying (K3)
CO5	apply the knowledge of cosmetics to explain the characteristics, formulation, preparation and quality control of different cosmetic products used in day to day life.	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1											
CO3	3	1												
CO4	3	2	1											
CO5	3	2	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO06 – NANOCOMPOSITE MATERIALS								
Programme& Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to equip the students to have knowledge on processing, characterization, properties, features and applications of nanocomposites.	
Unit – I	**Introduction of nanocomposites**	**9+3**
Introduction – nanocomposites – nanocomposites past and present – nomenclature – composite materials: introduction to solids - atomic and molecular solids – role of statistics in materials – primary, secondary and tertiary structure – transitions.		
Unit - II	**Properties and features of nanocomposites**	**9+3**
Properties: physics of modulus – continuum measurements – yield – fracture – rubbery elasticity and viscoelasticity – composites and nanocomposites – surface mechanical properties –diffusion and permeability – features of nanocomposites: basics of polymer nanocomposites - nano reinforcements – matrix materials – hazards of particles.		
Unit - III	**Processing of nanocomposites**	**9+3**
Viscosity: types of flow, experimental viscosity, non-newtonian flow -low-viscosity processing: solvent processing, particle behavior, in situ polymerization, post-forming, hazards of solvent processing - melt, high shear and direct processing: melting and softening, melt processes with small shears or low-shear rates flow, meltprocesses with large deformations or high-shear rates, thermo-kinetic processes.		
Unit - IV	**Characterization of nanocomposites**	**9+3**
Introduction to characterization – experiment design – sample preparation – imaging –structural characterization – scales in nanocomposites – texture – electromagnetic energy –visualization – physicochemical analysis – characterization of physical properties.		
Unit - V	**Applications of nanocomposites**	**9+3**
Nanocomposites – optical, structural applications – nanoparticulate systems with organic matrices – applications – biodegradable protein nanocomposites – applications-polypropylene nanocomposites – application as exterior automatic components – hybrid nanocomposite materials – application for corrosion protection.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Thomas E. Twardowski, “Introduction to Nanocomposite Materials – Properties, Processing, Characterization”, DesTech Publications, April 2007, for Units-I, II, III, IV.
2.	Klaus Friedrich, Stoyko Fakivov, Zhony Shang, “Polymer Composites from Nano – to Macro – scale”, Springer USA, 2005, for Units-I, II, V.

REFERENCES:

1.	Pulickel M. A, Linda S. S, Paul V.B, “Nanocomposite Science and Technology”, Wiley-VCH, 2006.
2.	Vikas Mittal, Characterization techniques for polymer nonocomposites, Wiley-VCH, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the knowledge of nanocomposites and to explain its structure.	Applying (K3)
CO2	apply the knowledge on various properties and features of nanocomposites.	Applying (K3)
CO3	choose the various concepts involving in the processing of nanocomposites.	Applying (K3)
CO4	apply the acquired knowledge on characterization of nanocomposites.	Applying (K3)
CO5	organize the applications of nanocomposites in various fields.	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO07 - WASTE AND HAZARDOUS WASTE MANAGEMENT

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	OE	3	0	0	3

Preamble	Waste and Hazardous waste management aims to equip the students to have a wide-range of knowledge on waste management.

Unit – I	Solid Waste Management	9

Solid wastes: definition, sources, types, composition of solid waste- Solid waste management system: collection, separation, processing and transformation of solid waste – combustion, aerobic composting, vermicomposting, pyrolysis, landfill-classification, types, methods and control of leachate in landfills - recycling of material found in municipal solid waste- recycling of paper and cardboard, recycling of plastics, recycling of glass.

Unit – II	Hazardous Waste Management	9

Hazardous wastes: definition, nature and sources of hazardous waste, classification and characteristics of hazardous waste- chemical class of hazardous waste, generation, segregation, treatment and disposal: waste reduction, waste minimization, recycling - chemical treatment: acid base neutralization, chemical precipitation, oxidation/reduction, hydrolysis, electrolysis, chemical extraction and leaching, ion exchange, photolytic reaction- thermal treatment methods: incineration – biodegradation of hazardous waste: aerobic, anaerobic, reductive dehalogenations - land treatment and composting.

Unit – III	E- Waste & Biomedical Waste Management	9

E-Waste Management: definition, sources, classification, collection, segregation, treatment and disposal.

Biomedical Waste Management : Introduction-definition –components of biomedical waste-waste generation –waste identification and waste control-waste storage-labeling and color coding-handling and transportation-waste treatment and disposal- autoclave, hydroclave , microwave treatments- chemical disinfection – sanitary and secure landfill.

Unit – IV	Pollution From Major Industries And Management	9

Introduction- sources and characteristics - waste treatment flow sheets for selected industries such as textiles, tanneries, pharmaceuticals, sugar, petroleum refinery, fertilizer and dairy industries.

Unit – V	Solid Waste Management and Legislation	9

Solid waste management plan - solid waste (management and handling) rules - biomedical waste (management and handling) rules- plastic waste management rules - e-waste management rules - hazardous and other wastes (management and transboundary movement) rules - construction and demolition waste management rules.

Total: 45

TEXT BOOK:

1.	George Tchobanoglous, Hillary Theisen, Samuel a Vigil, Integrated solid waste management (Engineering principle and management issues) McGraw hill Education (India) Pvt. Ltd., 2015, for Unit-I, II, V.
2.	SC Bhatia, Handbook of Industrial pollution and control (Volume-1), CBS Publisher and Distributers, New Delhi, 2002, for Unit-II, III, IV, V.

REFERENCES:

1.	Manual on Municipal Solid Waste management, Central public Health and Environmental Engineering Organization (CPHEEO), Govt. of India, May 2000.
2.	Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans, Hazardous waste management, MEDTEC, 2015.
3.	Majeti Narasimha Vara Prasad, Meththika Vithanage, Anwesha Borthakur, “Handbook of Electronic Waste Management: International Best Practices and Case Studies” 1st Edition, Butterworth-Heinemann, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the technical points that are required to set up a solid waste management system.	Applying (K3)
CO2	explain the various disposal and treatment methods of hazardous wastes.	Understanding (K2)
CO3	organize the appropriate method for managing e-waste and biomedical waste.	Applying (K3)
CO4	identify the hazards from various industries and apply the waste management techniques for its treatment.	Applying (K3)
CO5	relate the legal legislation to solid waste management.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1			3							
CO2	2	1					3							
CO3	3	2	1	1			3							
CO4	3	2	1	1			3							
CO5	2	1					3							

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO08 - CHEMISTRY IN EVERY DAY LIFE							
Programme& Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course aims to prepare the students to have the knowledge on oils, fats, sugar, adulterants in food, creams, milk powder, soil, fertilizer, pesticides, insecticides, fungicides and herbicides in order to know its chemistry in our everyday activities.	
Unit – I	**Oils, Fats and Sugar**	**9**
Distinction between oils and fats – properties – classification – edible oils – vegetable oils –animal oils – manufacture of oils by solvent extraction – refining of crude vegetable oils – processing of animal fats – manufacture of cane sugar – manufacture of sucrose from beet root.		
Unit – II	**Adulterants in food**	**9**
Food Adulteration and prevention – common food adulterants – food additives – food colorants– preservatives – flavourants – food poisoning – analysis of adulterants in edible oils, coffee powder, chilli powder, turmeric powder, meat , fish, ghee and milk – harmful effects of food adulterants		
Unit – III	**Creams and Milk powder**	**9**
Creams: Composition-chemistry of creaming process- Factors influencing cream separation (Mention the factors only) - Estimation of fat in cream - Milk powder: Need for making powder-drying process- spraying, drum drying, jet drying and foam drying-principles involved in each.		
Unit – IV	**Soil and Fertilizers**	**9**
Soil analysis: Composition of soil - Organic and Inorganic constituents-Soil acidity - buffering capacity of soils -Liming of soil - Fertilizers: primary nutrients –role of Nitrogen, potassium and phosphorous on plant growth –Complex fertilizers and mixed fertilizers and its composition - Secondary nutrients – micronutrients and their functions in plants -optimal addition of Fertilizers to obtain estimated yield.		
Unit – V	**Pesticides, Insecticides, Fungicides and Herbicides**	**9**
Pesticides – Classification – general methods of application and toxicity, Safety measures when using pesticides-Insecticides: Inorganic pesticides – borates - Organic pesticides – D.D.T. and BHC-Plant derivatives: pyrethrin and Nicotine - Synthetic organic pesticides: Endrin and Aldrin (Chemical name - Structure- functions and uses)-Fungicides: Inorganic (Bordeaux mixture) and organic (dithiocarbamate) fungicides - Industrial fungicides: Creosote fractions - Herbicides: Selective and non-selective - 2, 4-dicholorophenoxyacetic acid and 2,4,5-tricholorophenoxyaceticacid (structure and function).		
		Total: 45

TEXT BOOK:

1.	Sharma B K , Industrial Chemistry, Goel publishing house, New Delhi, 2011, for Units- I, II, IV
2.	Alex V Ramani, Food Chemistry, MJP Publishers, Chennai, 2009, for Units -II, III, V.

REFERENCES:

1.	Dilip Kumar Das, Introductory Soil Science, 1st Edition, Kalyani Publishers, Reprint 2002.
2.	K. Bagavathi Sundari– “Applied Chemistry”, MJP Publishers, Chennai, 2006.
3.	Ashutosh Kar, Medicinal Chemistry, Wiley Eastern limited, New Delhi, 1993.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the importance of oils, fats and sugar.	Understanding (K2)
CO2	identify the harmful effects of adulterants in food.	Applying (K3)
CO3	develop the knowledge on creams and milk powder.	Applying (K3)
CO4	interpret the nature and composition of soil and fertilizers.	Understanding (K2)
CO5	illustrate the difference of pesticides, insecticides, fungicides and herbicides.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1												
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22CYO09 - CHEMISTRY OF NUTRITION FOR WOMEN HEALTH

Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course aims to provide knowledge for engineering students on components of health, fitness and also the role of nutrition for women health.	
Unit 1	**Nutrition**	**9**

Energy- functions, sources and concept of energy balance - recommended dietary allowances, dietary sources - effects of deficiency and/ or excess consumption on health of the following nutrients: carbohydrates and dietary fibre – lipids – proteins - fat soluble vitamins: A, D,E and K - water soluble vitamins: Thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C – minerals: calcium, iron, zinc and iodine.

Unit 2	**Women Health**	**9**

Disease pattern and reproductive health- menopause – hypothyroid- PCOD-diabetes - policies and programs for promoting maternal and child nutrition and health - concept of small family - methods of family planning - merits and demerits.

Unit 3	**Nutrition for Nursing Mother and Infants**	**9**

Physiology and psychology of lactation, hormonal control, composition of colostrums and breast milk, nutritional requirements of a nursing mother, advantages of breast feeding, food and nutritional requirements for infants, weaning and supplementary foods for infants and immunization.

Unit 4	**Nutrition for Physical Fitness**	**9**

Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer - nutrition and exercise regimes for pre and postnatal fitness - nutritional and exercise regimes for management of obesity - critical review of various dietary regimes for weight and fat reduction - prevention of weight cycling.

Unit 5	**Role of Women in National Development**	**9**

Women in family and community: Demographic changes menarche, marriage, fertility, morbidity, mortality, life expectancy, sex ratio, aging, widowhood. Women in society: Women's role, their resources, and contribution to family, and effect of nutritional status.

Total: 45

TEXT BOOK:

1.	Srilakshmi, B., Nutrition Science, New Age International (P) Ltd., New Delhi, 2017, for Units- I, IV, V.
2.	Arpita Verma, Women's Health and Nutrition: Role of State and Voluntary Organizations, Rawat Publishers, 2017, for Units - II, III, IV.

REFERENCES:

1.	Shubhangini A Joshi , Nutrition and Dietetics, TataMacGraw Hill, 2010.
2.	Rujuta Diwekar, Women and The Weight Loss Tamasha, Westland ltd, 2010.
3.	Swaminathan, M., Advanced Textbook on Food and Nutrition, Vol. 1, Second Edition, Bangalore Printing and Publishing Co. Ltd., Bangalore, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of the knowledge of dietary sources in day to day life.	Applying (K3)
CO2	explain the disease pattern and policies towards women health.	Understanding (K2)
CO3	develop knowledge about nutrition during lactation and for infants.	Applying (K3)
CO4	utilize the knowledge of physical fitness and nutrition towards good health.	Applying (K3)
CO5	interpret the various role of women in society.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	1												
CO3	3	2	1											
CO4	3	2	1											
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

22GEO01 - GERMAN LANGUAGE LEVEL 1							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course serves as an introduction to the German language and awareness towards German lifestyle and cultural aspects of Germany and German speaking countries. One can learn to introduce oneself and able to gain the basic day to day vocabulary. On keen learning one would be able to understand the sentence structure and be able to reciprocate to basic questions	
Unit – I	**Good Day (Guten Tag)**	**9**
Greetings, Self-introduction and introducing others, Numbers, Alphabets, Countries and languages spoken. Grammar – W questions, Simple sentences, Verb conjugation and personal pronoun.		
Unit – II	**Friends & Colleague (Freund und Kollegen):**	**9**
Hobbies, Profession, Week, Months, Season and Generate Profile. Grammar – Articles, Plural, Verbs – have and to be, Yes/No questions.		
Unit – III	**n the City (In der Stadt):**	**9**
Name of places/buildings in the city, asking for directions, Understanding means of transport. Grammar – definite and indefinite articles, Negation articles and Imperative		
Unit – IV	**Food and Appointment (Essen und Termin):**	**9**
Food, Shopping, initiate conversations to understand and do shopping. Grammar – Accusative case, Verbs with Accusative. Understanding time and reciprocating, Appointments, Asking excuse, Family. Grammar – Prepositions: *am, um, von...bis,* Possessive articles- *mein, dein*.., Modal verbs- *müssen, können, wollen*		
Unit – V	**Socializing (Zeit mit Freunden):**	**9**
Planning together, Birthday, Invitation, Restaurant, looking for specific information in texts. Grammar – Separable verbs, Prepositions with Accusative case, Past tense of have and to be, Personal pronoun with Accusative.		
		Total:45

TEXT BOOK:	
1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.
REFERENCES:	
1.	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2.	https://www.dw.com/en/learn-german - Deutsche Welle, Geramany’s International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand structure of language and introducing each other	Remembering (K1)

CO2	understand vocabulary on seasons and basic verbs	Understanding (K2)
CO3	ask for directions in a new place and avail transport as required	Understanding (K2)
CO4	understand food habits of German and ask for appointments.	Understanding (K2)
CO5	learn to socialize in a German speaking country	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO02 - JAPANESE LANGUAGE LEVEL 1							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 55 Kanjis also enables one to greet, introduce oneself and other person and also provides the ability to understand basic day to day conversations	
Unit – I	**Introduction to Hiragana and Katakana:**	**9**
Chart 1, Chart 2, Chart 3, Annexures 1 and 2 and basic Japanese rules along with similar sounded vocabularies for each chart.		
Unit – II	**Introduction to Nouns, various particles and usages:**	**9**
Forming simple sentences, asking questions, positioning differentiation and owning fundamentals – new particles and usages		
Unit – III	**Introduction of Verbs, time and place markers:**	**9**
Usage of action words in sentences and framing them – place and time markers usages – giving and receiving – omission of certain particles in a sentence.		
Unit – IV	**Introduction of Adjectives, Adverbs and usages:**	**9**
Describing nouns and verbs and framing them to relate day to day conversations- positive and negative ending of the same – introduction of the likes and dislikes expressions		
Unit – V	**Introduction to Counters and Kanji:**	**9**
How to use numbers-How to use quantifiers-Present form of adjectives and Nouns-Other necessary particles-How to use numbers and quantifiers – 55 kanji characters		
		Total:45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	greet and introduce oneself and other	Understanding (K2)
CO3	communicate day to day conversations – basic level	Understanding (K2)

CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of numbers, days, months, time and counters	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO05-GERMAN LANGUAGE LEVEL 2							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	German Language Level 1	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations

Unit – I	**Contacts(Kontakte):**	**9**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit – II	**Accomodation(Die Wohnung):**	**9**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit – III	**Are you Working?(Arbeiten Sie):**	**9**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*		
Unit – IV	**Clothes and Style(Kleidung und mode):**	**9**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative		
Unit – V	**Health and Vacation(Gesundheit und Urlaub):**	**9**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*		
		Total:45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.
2.	

REFERENCES:

1.	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand letters and simple texts	Remembering (K1)
CO2	assimilate vocabulary on Accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understand how to do shopping in a German store	Understanding (K2)
CO5	understand body parts and how to plan personal travel	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO06-GERMAN LANGUAGE LEVEL 3							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	German Language Level 2	**All**	**OE**	**3**	**0**	**0**	**3**
Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations.						
Unit – I	**All about food (Rund Ums Essen):**						**9**
Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'							
Unit – II	**School days (Nach der Schulzeit):**						**9**
Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.							
Unit – III	**Media in everyday life (Medien in Alltag):**						**9**
To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with 'Als' and 'Wie', Subordinate clause with 'dass', Superlative degree.							
Unit – IV	**Feelings and expressions (Gefühle):**						**9**
Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with 'Wenn', Adjectives to be used along with definite articles.							
Unit – V	**Profession and Travel (Beruf und Reisen):**						**9**
To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – 'werden', Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.							
							Total:45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015
2.	

REFERENCES:

1.	Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (German)" , Goyal Publishers, Delhi, 2011.

2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand German food style, restaurant and be able express oneself.	Remembering (K1)
CO2	understand German school system and discuss about habits and provide City-Tipps	Understanding (K2)
CO3	analyze and compare media in everyday life.	Understanding (K2)
CO4	express feelings, describe a city and write blog entries.	Understanding (K2)
CO5	seek and provide information in a professional setup, give directions to others and talk about travel	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO07-GERMAN LANGUAGE LEVEL 4							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**German Language Level 3**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations.

Unit – I	**Learning (Lernen):**	**9**

Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ

Unit – II	**Athletic (Sportlich):**	**9**

Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ

Unit – III	**Living Together (Zusammen Leben):**	**9**

To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.

Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**

Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ

Unit – V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**

Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.

Total:45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch”, Goyal Publishers, Delhi, 2015.

REFERENCES:

1.	Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, “Tangram 2 (German)”, Goyal Publishers, Delhi, 2011.
2.	https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	leverage learning in Workplace, understanding reports and make presentation.	Remembering (K1)
CO2	reciprocate to different situations, make appointment and understand texts.	Understanding (K2)
CO3	handle relationships and respond appropriately to exchange information	Understanding (K2)
CO4	familiarize to various channels of entertainment	Understanding (K2)
CO5	know about various cultural aspects, usage of proverbs and cliches.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO08 - JAPANESE LANGUAGE LEVEL 2							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Japanese Language Level 1**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit – I	**Introduction to groups of verbs:**	**9**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit – II	**Introduction to Casual Form:**	**9**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit – III	**Express opinions and thoughts:**	**9**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit – IV	**Introduction to If clause and remaining Kanjis:**	**9**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis		
Unit – V	**Introduction to giving and receiving with te form and "when, even if" usages:**	**9**
Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.		
		Total:45

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017

REFERENCES:

1. Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	differentiate groups of verbs and its forms	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)

CO4	understand the Kanjis in Japanese Script and If clause	Understanding (K2)
CO5	comprehend concept of “even if”, “when” and job-related information	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO09 - JAPANESE LANGUAGE LEVEL 3								
(Common to All Engineering and Technology Branches)								
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Japanese Language Level 2**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life	
Unit – I	**Introduction to Potential verbs:**	**9**
Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.		
Unit – II	**Introduction to Transitive and Intransitive verbs:**	**9**
Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences- Conjunctions-Basic Questions and kanji's.		
Unit – III	**Introduction to Volitional forms:**	**9**
Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.		
Unit – IV	**Introduction to Imperative and Prohibitive verbs:**	**9**
Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.		
Unit – V	**Introduction to Conditional form and Passive verbs:**	**9**
Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		
		Total:45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.
2.	

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)

CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO10 -JAPANESE LANGUAGE LEVEL 4

(Common to All Engineering and Technology Branches)

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**JAPANESE LANGUAGE LEVEL 3**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people.	
Unit – I	**Introduction to Reasoning:**	**9**
Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's		
Unit – II	**Introduction to Exchanging of things:**	**9**
Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's.		
Unit – III	**Introduction to States of an Action:**	**9**
Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's.		
Unit – IV	**Introduction to Causative Verbs:**	**9**
Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's.		
Unit – V	**Introduction to Relationship in Social Status:**	**9**
Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's.		
		Total:45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.
2.	

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)

CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script..	Understanding (K2)
CO5	comprehend Orally Presented Materials.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO11 -FRENCH LANGUAGE LEVEL 1							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course provides a foundation of the French language as well as an understanding of the French culture and lifestyle of France and other French-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications	
Unit – I	**Introduction**	**9**
French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem), Salutations, numbers.		
Unit – II	**Daily Life**	**9**
Subject Pronoun, Francophonie's, adjectives – colors, week, months, seasons.		
Unit – III	**Articles and Verbs**	**9**
Articles - Indefinite, definite, partitive, and contracted, (examples), introductions to verbs, 1st group of verb		
Unit – IV	**In the City**	**9**
2nd group of verbs, irregular verbs (avoir, etre, faire …..) present yourself & negative sentences. (faire and Jouer verb with the expressions)		
Unit – V	**Food and Culture**	**9**
Prepositions – preposition of places (country, cities and etc), Imperative mode, invitations, culture – food (wine, cheese ….) Future (recent future)		
		Total:45

TEXT BOOK:

1.	A1 – saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G, Les idees – 0 and 1

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	Understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	Ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	Understand the food habits of France and ask for appointments	Understanding (K2)

CO5	Learn to socialize in French-speaking countries	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO12 -FRENCH LANGUAGE LEVEL 2

(Common to All Engineering and Technology Branches)

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Fundamentals of French Language**	**all**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course is designed to assist students in developing vocabulary in accordance with the Common European Framework of Reference for Languages at the A2 level. This course will aid in the integration of basic grammar structures as well as the acquisition of vocabulary necessary to comprehend and respond in everyday circumstances. The learner will be able to develop a thorough comprehension of French grammar and confidently express themselves in everyday circumstances.	
Unit – I	**French and You**	**9**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie world, Verbs (Regulars and irregulars), Reflexive Verbs, Prepositions		
Unit – II	**Eat and Repeat**	**9**
Favorite foods, Recopies, Types of meals, Describing House and Kitchen, Presentation of the recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form		
Unit – III	**Vacation**	**9**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense		
Unit – IV	**Likes and Views**	**9**
Favorite persons & things, Giving advice, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit – V	**Then and Now**	**9**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		
		Total:45

TEXT BOOK:

1.	A2 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G .Les idees – 0 and 1

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the French language in deep and its usage	Remembering (K1)
CO2	Preparation of their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	Converse about their vacation, their Favorite Destination	Understanding (K2)

CO4	Understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	Know the difference between Past and Present and Compare them.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO13- FRENCH LANGUAGE LEVEL 3							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course gives knowledge regarding a variety of personal and professional circumstances, as well as improving vocabulary and speaking abilities to reply to and seek information in those settings. It also gives you the ability to articulate yourself and arrange appointments. With perseverance, one can master all of the essential grammatical structures needed to respond confidently in everyday circumstances. It almost gives you an idea of how Natives communicate.	
Unit – I	**Start Over**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about the future (actions and situations), Hypothetical situations, Imperfect and future tense.		
Unit – II	**Prohibitions and More**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of the subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit – III	**Let's be Creative**	**9**
Write a letter by describing the problem, talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct, and Indirect		
Unit – IV	**Travel and Communication**	**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on the telephone, Roleplay (Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.		
Unit – V	**Let's Talk**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, the use of superlatives, Exclamatory phrases, subjunctives.		
		Total:45

TEXT BOOK:

1.	B1 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G Les idees – 0 and 1

COURSE OUTCOMES: **On completion of the course, the students will be able to**	**BT Mapped (Highest Level)**

CO1	Learn on Future tense.	Remembering (K1)
CO2	Understand Permissions and Prohibitions.	Understanding (K2)
CO3	Knowing about Letter writing, Creating Ads, Expressing Desires, and Instructing Others.	Understanding (K2)
CO4	Understanding rules for travel and Enhancing communications.	Understanding (K2)
CO5	Expressing the feelings and emotions using advanced grammar	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO15 - SPANISH LANGUAGE LEVEL 2							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the Learner to acquire the vocabulary as per theframework of Spanish language A2 level competence. This course will help to assimilate the basicgrammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the Spanish grammar and confidently articulate in day today situations.	
Unit – I	**Spanish and You (El Español y tú)**	**9**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, About favorite films and Types of screens in the movie world, Verbs(Regulars and irregulars), Reflexive Verbs, Prepositions		
Unit – II	**Eat and Repeat (**Comer y repetir**)**	**9**
Favorite foods, Recipies, Types of meals, Describing House and Kitchen, Presentation of recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form		
Unit – III	**Its Vacation Time (**Tiempo de vacaciones)	**9**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense, Usage of Todavia or No		
Unit – IV	**Likes and Views (**Gustasyvistas)	**9**
Favorite persons & things, Giving advices, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit – V	**Then and Now(Antes y Ahora)**	**9**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		
		Total:45

TEXT BOOK:

1.	AULA INTERNACIONAL 2 (A2) Jaime Corpas, AgusinGarmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: **On completion of the course, the students will be able to**	**BT Mapped (Highest Level)**

CO1	understand the Spanish language in deep and its usage	Remembering (K1)
CO2	prepare for their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	know the difference between Past and Present and Comparing them.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO16 - SPANISH LANGUAGE LEVEL 3							
(Common to All Engineering and Technology Branches)							
Programme& Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations. It almost gives a basic idea on how Natives speak.	
Unit – I	**Start Over(Volver a Empezar)**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about future (actions and situations),Hypothetical situations, Imperfect and future tense.		
Unit – II	**Prohibitions and More(Prohibiciones y mas)**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit – III	**Let’s be Creative (Seamoscreatives)**	**9**
Write a letter by describing the problem,talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct and Indirect.		
Unit – IV	**Travel and Communication (Viajar y comunicar)**	**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on telephone, Role play(Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.		
Unit – V	**Let’s Talk(Hablemos)**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, use of superlatives, Exclamatory phrases, subjunctive.		
		Total:45

TEXT BOOK:

1.	Aula International 3 (B1) [Paperback] Jaime Corpas, Agusin Garmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	learn on Future tense.	Remembering (K1)

CO2	understand about Permissions and Prohibitions.	Understanding (K2)
CO3	knowing about Letter writing, Creating Ads, Expressing Desires and Instructing Others.	Understanding (K2)
CO4	understanding rules for travel and Enhance communications.	Understanding (K2)
CO5	expressing the feelings and emotions using advanced grammar	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO01 - GERMAN LANGUAGE LEVEL 1								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course serves as an introduction to the German language and awareness towards German lifestyle and cultural aspects of Germany and German speaking countries. One can learn to introduce oneself and able to gain the basic day to day vocabulary. On keen learning one would be able to understand the sentence structure and be able to reciprocate to basic questions	
Unit – I	**Good Day (Guten Tag)**	**12**
Greetings, Self-introduction and introducing others, Numbers, Alphabets, Countries and languages spoken. Grammar – W questions, Simple sentences, Verb conjugation and personal pronoun.		
Unit – II	**Friends & Colleague (Freund und Kollegen):**	**12**
Hobbies, Profession, Week, Months, Season and Generate Profile. Grammar – Articles, Plural, Verbs – have and to be, Yes/No questions.		
Unit – III	**n the City (In der Stadt):**	**12**
Name of places/buildings in the city, asking for directions, Understanding means of transport. Grammar – definite and indefinite articles, Negation articles and Imperative		
Unit – IV	**Food and Appointment (Essen und Termin):**	**12**
Food, Shopping, initiate conversations to understand and do shopping. Grammar – Accusative case, Verbs with Accusative. Understanding time and reciprocating, Appointments, Asking excuse, Family. Grammar – Prepositions: *am, um, von...bis,* Possessive articles- *mein, dein*.., Modal verbs- *müssen, können, wollen*		
Unit – V	**Socializing (Zeit mit Freunden):**	**12**
Planning together, Birthday, Invitation, Restaurant, looking for specific information in texts. Grammar – Separable verbs, Prepositions with Accusative case, Past tense of have and to be, Personal pronoun with Accusative.		
		Total:60

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.

REFERENCES:

1.	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2.	https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand structure of language and introducing each other	Remembering (K1)
CO2	understand vocabulary on seasons and basic verbs	Understanding (K2)
CO3	ask for directions in a new place and avail transport as required	Understanding (K2)
CO4	understand food habits of German and ask for appointments.	Understanding (K2)
CO5	learn to socialize in a German speaking country	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

<table>
<tr><td colspan="8">22GEO02 - JAPANESE LANGUAGE LEVEL 1</td></tr>
<tr><td colspan="8">(Offered by Department of Electronics and Communication Engineering)</td></tr>
<tr><td>Programme& Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>All</td><td>OE</td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">The basic level of Japanese which provides understanding of Hiragana, Katakana and 55 Kanjis also enables one to greet, introduce oneself and other person and also provides the ability to understand basic day to day conversations</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction to Hiragana and Katakana:</td><td>12</td></tr>
<tr><td colspan="8">Chart 1, Chart 2, Chart 3, Annexures 1 and 2 and basic Japanese rules along with similar sounded vocabularies for each chart.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Introduction to Nouns, various particles and usages:</td><td>12</td></tr>
<tr><td colspan="8">Forming simple sentences, asking questions, positioning differentiation and owning fundamentals – new particles and usages</td></tr>
<tr><td>Unit – III</td><td colspan="6">Introduction of Verbs, time and place markers:</td><td>12</td></tr>
<tr><td colspan="8">Usage of action words in sentences and framing them – place and time markers usages – giving and receiving – omission of certain particles in a sentence.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Introduction of Adjectives, Adverbs and usages:</td><td>12</td></tr>
<tr><td colspan="8">Describing nouns and verbs and framing them to relate day to day conversations- positive and negative ending of the same – introduction of the likes and dislikes expressions</td></tr>
<tr><td>Unit – V</td><td colspan="6">Introduction to Counters and Kanji:</td><td>12</td></tr>
<tr><td colspan="8">How to use numbers-How to use quantifiers-Present form of adjectives and Nouns-Other necessary particles-How to use numbers and quantifiers – 55 kanji characters</td></tr>
<tr><td colspan="8" align="right">Total:60</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">“MINNA NO NIHONGO–Japanese for Everyone”, 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Margherita Pezzopane, “Try N5”, 2nd Edition, Tankobon Softcover, Japan, 2017.</td></tr>
<tr><td>2.</td><td colspan="7">Sayaka Kurashina, “Japanese Word Speedmaster”, 2nd Edition, Tankobon Softcover, Japan, 2018.</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	greet and introduce oneself and other	Understanding (K2)
CO3	communicate day to day conversations – basic level	Understanding (K2)
CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of numbers, days, months, time and counters	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO05 - GERMAN LANGUAGE LEVEL 2							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	German Language Level 1	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations
Unit – I	**Contacts(Kontakte): 12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.	
Unit – II	**Accomodation(Die Wohnung): 12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative	
Unit – III	**Are you Working?(Arbeiten Sie): 12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*	
Unit – IV	**Clothes and Style(Kleidung und mode): 12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative	
Unit – V	**Health and Vacation(Gesundheit und Urlaub): 12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*	
	Total:60

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.
2.	

REFERENCES:

1.	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand letters and simple texts	Remembering (K1)
CO2	assimilate vocabulary on Accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understand how to do shopping in a German store	Understanding (K2)
CO5	understand body parts and how to plan personal travel	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO06-GERMAN LANGUAGE LEVEL 3								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	German Language Level 2	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations.	
Unit – I	**All about food (Rund Ums Essen):**	**9**
Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'		
Unit – II	**School days (Nach der Schulzeit):**	**9**
Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.		
Unit – III	**Media in everyday life (Medien in Alltag):**	**9**
To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with 'Als' and 'Wie', Subordinate clause with 'dass', Superlative degree.		
Unit – IV	**Feelings and expressions (Gefühle):**	**9**
Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with 'Wenn', Adjectives to be used along with definite articles.		
Unit – V	**Profession and Travel (Beruf und Reisen):**	**9**
To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – 'werden', Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.		
		Total:45

TEXT BOOK:	
1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015
2.	

REFERENCES:	
1.	Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (German)" , Goyal Publishers, Delhi, 2011.
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand German food style, restaurant and be able express oneself.	Remembering (K1)
CO2	understand German school system and discuss about habits and provide City-Tipps	Understanding (K2)
CO3	analyze and compare media in everyday life.	Understanding (K2)
CO4	express feelings, describe a city and write blog entries.	Understanding (K2)
CO5	seek and provide information in a professional setup, give directions to others and talk about travel	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO07-GERMAN LANGUAGE LEVEL 4							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**German Language Level 3**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations.	
Unit – I	**Learning (Lernen):**	**9**
Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ		
Unit – II	**Athletic (Sportlich):**	**9**
Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ		
Unit – III	**Living Together (Zusammen Leben):**	**9**
To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.		
Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**
Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ		
Unit – V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**
Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.		
		Total:45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch", Goyal Publishers, Delhi, 2015.

REFERENCES:

1.	Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2.	https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	leverage learning in Workplace, understanding reports and make presentation.	Remembering (K1)
CO2	reciprocate to different situations, make appointment and understand texts.	Understanding (K2)
CO3	handle relationships and respond appropriately to exchange information	Understanding (K2)
CO4	familiarize to various channels of entertainment	Understanding (K2)
CO5	know about various cultural aspects, usage of proverbs and cliches.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO08 - JAPANESE LANGUAGE LEVEL 2							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Japanese Language Level 1**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit – I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit – II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit – III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit – IV	**Introduction to If clause and remaining Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis		
Unit – V	**Introduction to giving and receiving with te form and "when, even if" usages:**	**12**
Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.		
		Total:60

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	differentiate groups of verbs and its forms	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script and If clause	Understanding (K2)
CO5	comprehend concept of “even if”, “when” and job-related information	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

<table>
<tr><td colspan="8">22GEO09 - JAPANESE LANGUAGE LEVEL 3</td></tr>
<tr><td colspan="8">(Offered by Department of Electronics and Communication Engineering)</td></tr>
<tr><td>Programme& Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Japanese Language Level 2</td><td>All</td><td>OE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction to Potential verbs:</td><td>9</td></tr>
<tr><td colspan="8">Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Introduction to Transitive and Intransitive verbs:</td><td>9</td></tr>
<tr><td colspan="8">Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences- Conjunctions-Basic Questions and kanji's.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Introduction to Volitional forms:</td><td>9</td></tr>
<tr><td colspan="8">Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Introduction to Imperative and Prohibitive verbs:</td><td>9</td></tr>
<tr><td colspan="8">Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Introduction to Conditional form and Passive verbs:</td><td>9</td></tr>
<tr><td colspan="8">Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.</td></tr>
<tr><td colspan="8">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.</td></tr>
<tr><td>2.</td><td colspan="7">Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)
CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO10 -JAPANESE LANGUAGE LEVEL 4							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**JAPANESE LANGUAGE LEVEL 3**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people.	
Unit – I	**Introduction to Reasoning:**	**9**
Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's		
Unit – II	**Introduction to Exchanging of things:**	**9**
Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's.		
Unit – III	**Introduction to States of an Action:**	**9**
Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's.		
Unit – IV	**Introduction to Causative Verbs:**	**9**
Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's.		
Unit – V	**Introduction to Relationship in Social Status:**	**9**
Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's.		
		Total:45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)
CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script..	Understanding (K2)
CO5	comprehend Orally Presented Materials.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO11 - FRENCH LANGUAGE LEVEL 1							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course provides a foundation of the French language as well as an understanding of the French culture and lifestyle of France and other French-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications

Unit – I	**Introduction**	**12**
French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem), Salutations, numbers.		
Unit – II	**Daily Life**	**12**
Subject Pronoun, Francophonie's, adjectives – colors, week, months, seasons.		
Unit – III	**Articles and Verbs**	**12**
Articles - Indefinite, definite, partitive, and contracted, (examples), introductions to verbs, 1st group of verb		
Unit – IV	**In the City**	**12**
2nd group of verbs, irregular verbs (avoir, etre, faire …..) present yourself & negative sentences. (faire and Jouer verb with the expressions)		
Unit – V	**Food and Culture**	**12**
Prepositions – preposition of places (country, cities and etc), Imperative mode, invitations, culture – food (wine, cheese ….) Future (recent future)		
		Total:60

TEXT BOOK:

1.	A1 – saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G, Les idees – 0 and 1

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	Understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	Ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	Understand the food habits of France and ask for appointments	Understanding (K2)
CO5	Learn to socialize in French-speaking countries	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO12 -FRENCH LANGUAGE LEVEL 2							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course is designed to assist students in developing vocabulary in accordance with the Common European Framework of Reference for Languages at the A2 level. This course will aid in the integration of basic grammar structures as well as the acquisition of vocabulary necessary to comprehend and respond in everyday circumstances. The learner will be able to develop a thorough comprehension of French grammar and confidently express themselves in everyday circumstances.

Unit – I	**French and You**	**12**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie world, Verbs (Regulars and irregulars), Reflexive Verbs, Prepositions		
Unit – II	**Eat and Repeat**	**12**
Favorite foods, Recopies, Types of meals, Describing House and Kitchen, Presentation of the recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form		
Unit – III	**Vacation**	**12**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense		
Unit – IV	**Likes and Views**	**12**
Favorite persons & things, Giving advice, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit – V	**Then and Now**	**12**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		
		Total:60

TEXT BOOK:

1.	A2 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G .Les idees – 0 and 1

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the French language in deep and its usage	Remembering (K1)
CO2	Preparation of their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	Converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	Understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	Know the difference between Past and Present and Compare them.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO13- FRENCH LANGUAGE LEVEL 3							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course gives knowledge regarding a variety of personal and professional circumstances, as well as improving vocabulary and speaking abilities to reply to and seek information in those settings. It also gives you the ability to articulate yourself and arrange appointments. With perseverance, one can master all of the essential grammatical structures needed to respond confidently in everyday circumstances. It almost gives you an idea of how Natives communicate.	
Unit – I	**Start Over**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about the future (actions and situations), Hypothetical situations, Imperfect and future tense.		
Unit – II	**Prohibitions and More**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of the subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit – III	**Let's be Creative**	**9**
Write a letter by describing the problem, talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct, and Indirect		
Unit – IV	**Travel and Communication**	**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on the telephone, Roleplay (Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.		
Unit – V	**Let's Talk**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, the use of superlatives, Exclamatory phrases, subjunctives.		
		Total:45

TEXT BOOK:

1.	B1 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Learn on Future tense.	Remembering (K1)
CO2	Understand Permissions and Prohibitions.	Understanding (K2)
CO3	Knowing about Letter writing, Creating Ads, Expressing Desires, and Instructing Others.	Understanding (K2)
CO4	Understanding rules for travel and Enhancing communications.	Understanding (K2)
CO5	Expressing the feelings and emotions using advanced grammar	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO14 - SPANISH LANGUAGE LEVEL 1								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**0**	**4**
Preamble	This course provides a foundation of the Spanish language as well as an understanding of the Spanish culture and lifestyle of Spain and other Spanish-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications.						
Unit – I	**Greetings and Good byes (Los Saludos y Despidirse):**						**12**
Greetings,Self-Introduction , Formal and Informal ways of introducing oneself and others, Alphabets& Numbers, Countries and Languages Spoken, Parts of Grammar – Noun, Personal Pronoun, Describe surroundings and its vocabulary							
Unit – II	**Vida Cotidiana (Daily Life):**						**12**
Time of the day, Days of the week, Months of the year, Seasons, Verb (To be, To Have), Adverbs, Likes and Dislikes, Personality and physical description, simple sentences							
Unit – III	**Friends and Family (Amigos y La Familia):**						**12**
Vocabulary of family, Animals, Professions, Parts of the body, Opinions on family cultures, Articles – Definite and Indefinite, Hobbies, Regular and Irregular verbs.							
Unit – IV	**In the City (En la Cuidad):**						**12**
Buildings in the city, Name of the places, asking for directions, Helping each other, Description of house and its components, Modes of Transport, Grammar - Possessive articles, prepositions							
Unit – V	**Food and Culture(La comida y cultura):**						**12**
Food (types and varieties) , shopping, ordering at a restaurant, inviting to parties, Roleplay (as diner and customer, salesman and customer…etc.) Past tense (all three tenses-Past Participle, Indefinite past and past imperfect- (to be and to have)							
							Total:60

TEXT BOOK:

1.	Chicos Chicas Libro de Alumno nivel 1, Ma Angeles Palomino , edelsa, GRUPO DIDASCALIA, S.A., plaza cuidad de salta,3-28043 MADRID(ESPANA).

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	understand the food habits of Spain and Latin countries and ask for appointments	Understanding (K2)
CO5	learn to socialize in Spanish speaking countries	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO15 - SPANISH LANGUAGE LEVEL 2							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the Learner to acquire the vocabulary as per theframework of Spanish language A2 level competence. This course will help to assimilate the basicgrammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the Spanish grammar and confidently articulate in day today situations.	
Unit – I	**Spanish and You (El Español y tú)**	**12**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, About favorite films and Types of screens in the movie world, Verbs(Regulars and irregulars), Reflexive Verbs, Prepositions		
Unit – II	**Eat and Repeat (**Comer y repetir**)**	**12**
Favorite foods, Recipies, Types of meals, Describing House and Kitchen, Presentation of recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form		
Unit – III	**Its Vacation Time (**Tiempo de vacaciones)	**12**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense, Usage of Todavia or No		
Unit – IV	**Likes and Views (**Gustasyvistas)	**12**
Favorite persons & things, Giving advices, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit – V	**Then and Now(Antes y Ahora)**	**12**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		
		Total:60

TEXT BOOK:

1.	AULA INTERNACIONAL 2 (A2) Jaime Corpas, AgusinGarmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the Spanish language in deep and its usage	Remembering (K1)
CO2	prepare for their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	know the difference between Past and Present and Comparing them.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEO16 - SPANISH LANGUAGE LEVEL 3							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations. It almost gives a basic idea on how Natives speak.	
Unit – I	**Start Over(Volver a Empezar)**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about future (actions and situations),Hypothetical situations, Imperfect and future tense.		
Unit – II	**Prohibitions and More(Prohibiciones y mas)**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit – III	**Let's be Creative (Seamoscreatives)**	**9**
Write a letter by describing the problem,talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct and Indirect.		
Unit – IV	**Travel and Communication (Viajar y comunicar)**	**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on telephone, Role play(Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.		
Unit – V	**Let's Talk(Hablemos)**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, use of superlatives, Exclamatory phrases, subjunctive.		
		Total:45

TEXT BOOK:

1.	Aula International 3 (B1) [Paperback] Jaime Corpas, Agusin Garmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	learn on Future tense.	Remembering (K1)
CO2	understand about Permissions and Prohibitions.	Understanding (K2)
CO3	knowing about Letter writing, Creating Ads, Expressing Desires and Instructing Others.	Understanding (K2)
CO4	understanding rules for travel and Enhance communications.	Understanding (K2)
CO5	expressing the feelings and emotions using advanced grammar	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE-638060

(AUTONOMOUS)

BOARD OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEGREE &PROGRAMME : BE Degree in Electronics and Communication Engineering

HONOURS DEGREE TITLE : System on Chip Design

The following courses are identified to earn additional 18 credits to get a Honors degree with specialization in System on Chip Design.

S.No	Course Title	Credits	Prerequisites	Semester
1.	22ECH01- VLSI Design Flow: Front end	4	Digital Electronics	5
2.	22ECH02 -C based VLSI Design	3	VLSI design	5
3.	22ECJ01-VLSI Design Flow: Back end	4	VLSI design	6
4.	22ECJ02-VLSI Technology	4	Semiconductor Physics	6
5.	22ECH03-Hardware Security	3	VLSI Design	7
	TOTAL	18		

22ECH01-VLSI DESIGN FLOW: FRONT END							
Programme & Branch	**BE & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Electronics**	**V**	**PC**	**3**	**1**	**0**	**4**

Preamble	To develop skills in front end design flow of modern chip design	
Unit – I	**Overview of Design Flow**	**9**
RTL to GDS Implementation: Logic Synthesis, Physical Design; Verification and Testing; Post-GDS Processes		
Unit – II	**Synthesis and Logic Optimization**	**9**
Verilog Constructs to Hardware, Logic Optimization: Definitions, Two-level logic optimization-Multi-level logic optimization, FSM Optimization		
Unit – III	**Formal Verification**	**9**
Formal Verification: Introduction, Formal Engines: BDD - SAT Solver- Model Checking, Combinational Equivalence Checking, Technology Library: Delay models of Combinational and Sequential Cells		
Unit – IV	**Static Timing Analysis**	**9**
Synchronous Behavior, Timing Requirements, Timing Graph, Delay Calculation, Graph-based Analysis, Path-based Analysis, Accounting for Variations		
Unit – V	**Constraints**	**9**
Clock, I/O, Timing Exceptions Technology Mapping Timing-driven Optimizations- Power Analysis, Power-driven Optimizations		
Lecture:45, Tutorials:15, Total:60		

TEXT BOOK:

1.	Saurabh Sneh, “Introduction to VLSI Design Flow”, Cambridge University Press, 2023.
2.	J. Bhasker and R. Chadha, “Static timing analysis for nanometer designs: A practical approach”, Springer Science Business Media, 2009
3.	G. D. Micheli, “Synthesis and optimization of digital circuits”, McGraw-Hill Higher Education, 1994
4.	https://onlinecourses.nptel.ac.in/noc23_ee137

REFERENCES:

1.	M.J.S. Smith, “Application-specific integrated circuits”, Addison-Wesley, 1997
2.	L. Lavagno, I. L. Markov, G. Martin, and L. K. Scheffer (Editors), “Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology”, CRC Press, 2016

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand various steps involved in VLSI design flow	Understanding (K2)
CO2	infer the role of synthesis and logic optimization formal verification	Understanding (K2)
CO3	comprehend the need of formal verification	Understanding (K2)
CO4	explain the need of timing analysis	Understanding (K2)
CO5	elucidate the role of timing and power constraints	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1				3				2	1	3
CO2	3	2	1	1				3				2	1	3
CO3	3	2	1	1				3				2	1	3
CO4	3	2	1	1				3				2	1	3
CO5	3	2	1	1				3				2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80		-	-	-	100
CAT2	20	80		-	-	-	100
CAT3	20	80		-	-	-	100
ESE	15	85		-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECH02- C BASED VLSI DESIGN

Programme & Branch	BE & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**VLSI Design**	**V**	**PC**	**3**	**0**	**0**	**3**

Preamble	To infer the VLSI design using C

Unit – I	**Scheduling**	**9**
Problem formulation - ILP Formulation – MRLC and MLRC Scheduling – Multiprocessor Scheduling – Hu's algorithm – List based Scheduling of MLRC – Advanced Scheduling – Forced Directed Scheduling - Forced Directed MRLC and MLRC Scheduling Algorithm- Path based Scheduling		
Unit – II	**Allocation and binding**	**9**
Problem Formulation – Left edge algorithm- ILP Based formulation- Allocation and Binding of Hierarchical Graph – Register Allocation and Binding- Multi port Binding Problem- Datapath and controller Synthesis		
Unit – III	**Efficient Synthesis of C code**	**9**
HLS for Arrays- HLS for Loops-pipeline- Hardware efficient C Coding- Dataflow optimization in HLS		
Unit – IV	**Impact of Compiler and Optimization in hardware**	**9**
Front end optimization in C – HLS Optimization – Simulation based Verification- RTL to C Reverse Engineering- Phase-wise verification of HLS- Equivalence between C and RTL		
Unit – V	**Securing Design with HLS**	**9**
Hardware Security- HLS for security- Attacks on RTL Logic locking		
		Total:45

TEXT BOOK:

1.	D. D. Gajski, N. D. Dutt, A.C.-H. Wu and S.Y.-L. Lin, High-Level Synthesis: Introduction to Chip and System Design, Springer, 1st edition, 1992
2.	G. De Micheli. Synthesis and optimization of digital circuits, McGraw Hill, India Edition, 2003
3.	Mike Fingeroff, High-Level Synthesis Blue Book, Mentor Graphics Corporation, 2010
4.	https://onlinecourses.nptel.ac.in/noc22_cs109/

REFERENCES:

1.	Philippe Coussy and Adam Morawiec, High-level Synthesis from Algorithm to Digital Circuit, Springer, 2008
2.	David. C. Ku and G. De Micheli, High-level Syntehsis of ASICs Under Timing and Synchronization Constraints, Kluwer Academic Publishers, 1992.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the overall HLS flow	Understanding (K2)
CO2	Infer how a C-code will be converted to its equivalent hardware	Understanding (K2)
CO3	Comprehend c-code for efficient hardware generation	Understanding (K2)
CO4	Learn how the common software compiler optimization help to improve the circuit performance.	Understanding (K2)
CO5	Secure the design with HLS	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	1	1				3				2	1	3
CO2	3	2	1	1				3				2	1	3
CO3	3	2	1	1				3				2	1	3
CO4	3	2	1	1				3				2	1	3
CO5	3	2	1	1				3				2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85		-	-	-	100
CAT2	15	85		-	-	-	100
CAT3	15	85		-	-	-	100
ESE	15	85		-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECJ01-VLSI DESIGN FLOW: BACK END

Programme & Branch	**B.E. & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**VLSI design**	**VI**	**PC**	**3**	**0**	**2**	**4**

Preamble	To develop skills in back end design flow of modern chip design	
Unit – I	**Introduction to Physical Design**	**9**
IC Fabrication :FEOL, BEOL, Interconnect/Wires, Interconnects and Parasitics, Signal Integrity, Antenna Effect, LEF files		
Unit – II	**Chip Planning**	**9**
Partitioning, Budgeting, Block Implementation, Top-level Assembly, Floorplanning, Power Planning		
Unit – III	**Placement**	**9**
Global Placement, Wire length Estimates, Legalization, Detailed Placement, Timing-driven Placement, Scan Cell Reordering, Spare Cell Placement		
Unit – IV	**Clock Tree Synthesis and Routing**	**9**
Terminologies, Clock Distribution Networks, Clock Network Architectures, Useful Skews, Global and Detailed, Post-routing Optimizations		
Unit – V	**Physical Verification**	**9**
Layout Extraction, LVS, ERC, DRC, ECO and Sign-off		

LIST OF EXPERIMENTS / EXERCISES:

For the following circuits,
a) Perform the functional verification
b) Synthesis the design
c) Generate the layout (Automatic)
d) Tabulate the area, power, delay

1.	16-bit Binary Counter
2.	First In First Out
3.	Booth Multiplier
4.	GCD Processor
5.	Universal Asynchronous Receiver Transmitter

Lecture:45, Practical: 15, Total:60

TEXT BOOK:

1.	Saurabh Sneh, "*Introduction to VLSI Design Flow*", Cambridge University Press, 2023.
2.	J. Bhasker and R. Chadha, "Static timing analysis for nanometer designs: A practical approach", Springer Science Business Media, 2009
3.	G. D. Micheli, "Synthesis and optimization of digital circuits", McGraw-Hill Higher Education, 1994
4.	https://onlinecourses.nptel.ac.in/noc23_ee137

REFERENCES/ MANUAL / SOFTWARE:

1.	M.J.S. Smith, "Application-specific integrated circuits", Addison-Wesley, 1997
2.	L.Lavagno, I. L. Markov, G. Martin, and L. K. Scheffer (Editors), "Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology", CRC Press, 2016

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand various steps involved in Physical design flow	Understanding (K2)
CO2	Infer the role of chip planning	Understanding (K2)
CO3	Comprehend the various tasks involved in placement	Understanding (K2)
CO4	demonstrate the various tasks involved in clock tree synthesis and routing	Understanding (K2)
CO5	illustrate the various tasks involved in physical verification	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1				3				2	1	3
CO2	3	2	1	1				3				2	1	3
CO3	3	2	1	1				3				2	1	3
CO4	3	2	1	1				3				2	1	3
CO5	3	2	1	1				3				2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	20	80					100
ESE	15	85					100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECJ02- VLSI TECHNOLOGY

Programme & Branch	**B.E. & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Semiconductor Physics**	**8**	**PC**	**3**	**0**	**2**	**4**

Preamble	To infer the foundations in MOS and CMOS fabrication process.	
Unit – I	**Crystal Growth and Epitaxy:**	**9**
Silicon Crystal Growth from the Melt- Silicon Float-Zone Process- GaAs Crystal-Growth Techniques -Material Characterization- Epitaxial-Growth Techniques - Structures and Defects in Epitaxial Layers		
Unit – II	**Film Formation:**	**9**
Thermal Oxidation- Chemical Vapor Deposition of Dielectrics - Chemical Vapor Deposition of Polysilicon- Atom Layer Deposition- Metallization		
Unit – III	**Lithography and Etching:**	**9**
Optical Lithography- Next-Generation Lithographic Methods- Wet Chemical Etching- Dry Etching		
Unit – IV	**Impurity Doping:**	**9**
Basic Diffusion Process- Extrinsic Diffusion- Diffusion-Related Processes- Range of Implanted Ions- Implant Damage and Annealing- Implantation-Related Processes		
Unit – V	**VLSI Process Integration:**	**9**
Integrated Devices – Passive Components- Bipolar Technology- MOSFET Technology- MESFET Technology- Challenges for Nanoelectronics.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Synthesis of 2-D materials using hummer's method
2.	Structural and Electrochemical Characterization of 2-D materials
3.	Study of Spin coater and CVD
4.	Design and development of controlled thin film using spin coater
5.	Design and development of transistor using spin coater
6.	Analysis of transistor performance using CE configuration

Lecture:60, Practical:15, Total:75

TEXT BOOK:

1.	Simon Sze, Ming-Kwei Lee "Semiconductor Devices Physics and Technology" 3rd Edition, Wiley, 2012, for Units I, II, III, IV, V.
2.	Sze S.M "VLSI Technology" , 2nd , McGraw-Hill New York, 2017.

REFERENCES:

1.	Amar Mukherjee Introduction to NMOS and CMOS VLSI System Design, Ist, Prentice Hall India, New Delhi, 2000.
2.	Plummer, James D., Deal, Michael D. and Griffin, Peter B., "Silicon VLSI Technology: Fundamentals Practice and Modeling", Prentice Hall India, New Delhi, 2000.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	summarize the approach for wafer preparation- Epitaxy	Understanding (K2)
CO2	Infer the techniques of Oxidation	Understanding (K2)
CO3	distinguish the various methods for lithography and etching	Understanding (K2)
CO4	illustrate the various Deposition and implantation process	Understanding (K2)
CO5	realize the various IC technology	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1									2	2	2
CO2	3	2	1									2	2	2
CO3	3	2	1									2	2	2
CO4	3	2	1									2	2	2
CO5	3	2	1									2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-	-	-	-	100
CAT2	20	80	-	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	20	80	-	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22ECH03- HARDWARE SECURITY							
Programme & Branch	**BE & Electronics and Communication Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**VLSI Design**	**VII**	**PC**	**3**	**0**	**0**	**3**

Preamble	To understand the basics of hardware security, hardware Trojan attacks in IPs and FPGAs, sidechannel attacks and hardware Trojan prevention	
Unit – I	**Introduction to Hardware Trojan and Hardware Trojan attacks**	**9**
Overview of Hardware Trojans- Trends, Tradeoffs and Threats of Trojans- Comparisons and Misconceptions with Trojan Attacks- Offensive Strategies- Defensive Strategies -Challenges of SoC Security- SoC Threat Model- SoC Security Assurance		
Unit – II	**Hardware IP Trust**	**9**
Trojan Characteristics – Inadequacies of existing testing and security features- Trojan classification – General Trojan Mitigation techniques- Trojan Mitigation at IP Level		
Unit – III	**Side-Channel Attacks**	**9**
Taxonomy of Side-Channel Attacks – Power Analysis Attacks- Electromagnetic Side-Channel Attacks- Fault Injection Attacks- Timing Attacks.		
Unit – IV	**Hardware Trojan Prevention**	**9**
Obfuscation- Role of Obfuscation in Hardware Trojan Prevention- Chip-Level Obfuscation- FPGA Obfuscation- Board Level Obfuscation- Evaluation Metrics for Hardware Obfuscation – Physical Unclonable Function.		
Unit – V	**Hardware Trojan Attacks in FPGA and Protection Approaches**	**9**
Threat Models and Taxonomy- Trojans in FPGA Fabric- Trojans in FPGA Design- Trojan in Bit stream- Countermeasures against FPGA Trojans.		
		Total:45

TEXT BOOK:

1.	Swarup Bhunia, and M. Tehranipoor, "The Hardware Trojan War." *Springer* (2018).
2.	Swarup Bhunia, and Mark Tehranipoor, "*Hardware security: a hands-on learning approach*", Morgan Kaufmann, 2018.
3.	Forte, Domenic, Swarup Bhunia, and Mark M. Tehranipoor, "*Hardware protection through obfuscation*", Berlin/Heidelberg, Germany: Springer International Publishing, 2017.

REFERENCES:

1.	Roel Maes, "*Physically unclonable functions: Constructions, properties and applications*" Springer Science & Business Media, 2013.
2.	Swarup Bhunia, Sandip Ray, and Susmita Sur-Kolay "*Fundamentals of IP and SoC security*" New York: Springer, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the offensive and defensive strategies of hardware Trojan	Understanding (K2)
CO2	Understand the classification of Trojan and mitigation techniques of hardware Trojan	Understanding (K2)
CO3	Understand the various forms of side channel attacks	Understanding (K2)
CO4	understand the various types of obfuscation techniques and physical unclonable function	Understanding (K2)
CO5	understand the various types of FPGA Trojans	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1									2	2	2
CO2	3	2	1									2	2	2
CO3	3	2	1									2	2	2
CO4	3	2	1									2	2	2
CO5	3	2	1									2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85		-	-	-	100
CAT2	15	85		-	-	-	100
CAT3	15	85		-	-	-	100
ESE	15	85		-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)