

# **KONGU ENGINEERING COLLEGE**

(Autonomous Institution Affiliated to Anna University, Chennai)

**PERUNDURAI ERODE – 638 060**

**TAMILNADU INDIA**



## **REGULATIONS, CURRICULUM & SYLLABI - 2020**

**(CHOICE BASED CREDIT SYSTEM AND  
OUTCOME BASED EDUCATION)**

**(For the students admitted during 2020 - 2021 and onwards)**

### **BACHELOR OF ENGINEERING DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING**

**DEPARTMENT OF ELECTRONICS AND  
COMMUNICATION ENGINEERING**





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Kongu Engineering College, Perundurai, Erode – 638060, India

**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:	
<b>PSO1</b>	<b>Products Development :</b> Apply multidisciplinary knowledge and skills to develop products for providing solutions for the real world problems in Industry, Agriculture, Healthcare, Communication etc.
<b>PSO2</b>	<b>Development of Entrepreneurship:</b> 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



**(Autonomous)**

**REGULATIONS 2020**

**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 2020 – 2021 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” means authorized person who is responsible for all examination related activities of the College.
- xi. “Head of the Department” means Head of the Department concerned of the College.



## 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 in relevant branches of study.

(OR)

The candidates who hold a BSc degree (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 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
- 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 Training, Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship 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 169.

#### 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 8.0 CGPA and no history of arrears during the entire programme to opt for the honours degree.

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 Augmented 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, internship and entrepreneurship/start ups during the programme to gain/exhibit the knowledge/skills.

#### **4.3.1 Professional Skills Training/ Industrial Training/Entrepreneurships/Start Ups**

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 fifth semester and phase-II in sixth 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 sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training Phase-II in sixth semester. He/She shall attend Professional Skills Training Phase-I in fifth 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 a maximum of 2 credits per semester for two semesters each in place of either Professional Skills Training-I / II or Industrial Training-I/ II respectively. 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 & 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 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-I Phase-II 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 Value Added 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 Value Added 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.

#### **4.4 Value Added Courses / Online Courses / Self Study Courses**

The candidates may optionally undergo Value Added Courses / Online Courses / Self Study Courses as elective courses.

**4.4.1 Value Added Courses:** Value Added courses each with One / Two credits shall be offered by the college with the prior approval from the respective Board of Studies. A candidate can earn a maximum of six credits through value added 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 value added 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 eighth 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. Total number of credits of such courses during the entire programme of study cannot exceed eight.
- 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), 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, Project Work, Professional Skills Training / Industrial Training, Internship 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:

<b>Sl. No.</b>	<b>Category of Course</b>	<b>Continuous Assessment Marks</b>	<b>End Semester Examination Marks</b>
1.	Theory / Practical	50	50
2.	Theory cum Practical	The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.	
3.	Professional Skills Training / / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work - I / Industrial Training / Mandatory Course	100	---
4.	Project Work-II Phase-I / Project Work-II Phase-II / Internships	50	50
5.	Value Added Course	The distribution of marks shall be decided based on the credit weightage assigned	---
6.	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 entrepreneurs/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 50 marks and the end semester examination shall be for 50 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. 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:

<b>Sl. No.</b>	<b>Type</b>	<b>Max. Marks</b>	<b>Remarks</b>
1.	Test - I	30	Average of best two
	Test - II	30	
	Test - III	30	
2.	Tutorial	15	Should be of Open Book/Objective Type. Average of best 4 (or more, depending on the nature of the course, as may be approved by Principal)
3.	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		50	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 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 50 marks and the end semester examination shall be for 50 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidate's 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.

## **7.6 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 (both Phase-I and 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	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Ext. Exr.	Guide	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 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 guide 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 Phase-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 Commi tee	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Review Committee	Guide	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 4<sup>th</sup> semester vacation and during 5<sup>th</sup> semester. Phase-II training shall be conducted for minimum of 80 hours in 5<sup>th</sup> semester vacation and during 6<sup>th</sup> semester. The evaluation procedure shall be approved by 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 two credits in sixth semester respectively 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 Projects through Internships**

Each candidate shall submit a brief report about the project through internship undergone and a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work-II as per clause 7.6.

### **7.12 Value Added Course**

Minimum of two assessments shall be conducted during the value added course duration by the offering department concerned.

### **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 SF (Satisfactory). 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 Course**

A candidate shall attend and complete the induction training program of duration three weeks at the beginning of the first semester. It is mandatory for all candidates who have joined in various branches of all BE/BTech programmes. No credits shall be given for such courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Since these courses have no grade points assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

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

Courses such as YVHD and UHV shall be offered to all candidates of all BE/BTech programmes. 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 entrepreneurship/ 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

Range of % of Total Marks	Letter Grade	Grade Point
91 to 100	O (Outstanding)	10
81 to 90	A+ (Excellent)	9
71 to 80	A (Very Good)	8
61 to 70	B+ (Good)	7
50 to 60	B (Average)	6
Less than 50	RA (Reappear)	0
Satisfactory	SF	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

- Successfully completed all the courses under the different categories, as specified in the regulations.
- 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).



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- iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2020 (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 and 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 7.00

### **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 Honours 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 8.00

## **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 Kongu Engineering 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										
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	4	3				3		13	7.7 %
BS	11	11	4	4					30	17.75 %
ES	4	4	4	8					20	11.8 %
PC	4	4	12	8	12	12	4		56	33.15 %
PE					3		12	3	18	10.65 %
OE				4	4	3		3	14	8.3 %
EC					2	6	3	7	18	10.65 %
<b>Semester wise Total</b>	<b>22</b>	<b>23</b>	<b>23</b>	<b>24</b>	<b>21</b>	<b>21</b>	<b>22</b>	<b>13</b>	<b>169</b>	<b>100.00</b>

CATEGORISATION OF COURSES								
HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)								
S. No.	Course Code	Course Name	L	T	P	C	Sem	
1.	20EGT11	English Language Skills	3	0	0	3	I	
2.	20EGT21	Advanced Communication Skills	3	0	0	3	II	
3.	20VEC11	Yoga and Values for Holistic Development	1	0	1	1	II	
4.	20EGL31	English for Workplace Communication Laboratory	0	0	2	1	III	
5.	20GET31	Universal Human Values	2	0	0	2	III	
6.	20GET71	Engineering Economics and Management	3	0	0	3	VII	
<b>Total Credits to be earned</b>						<b>13</b>		



<b>BASIC SCIENCE (BS)</b>							
<b>S. No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Sem</b>
1.	20MAC11	Matrices and Differential Equations	3	1*	2*	4	I
2.	20PHT11	Applied Physics	3	0	0	3	I
3.	20CYT11	Applied Chemistry	3	0	0	3	I
4.	20PHL11	Physical Sciences Laboratory I	0	0	2	1	I
5.	20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	II
6.	20PHT23	Physics for Communication and Computer Science Engineering	3	0	0	3	II
7.	20CYT23	Chemistry of Electronic Materials	3	0	0	3	II
8.	20PHL24	Physical Sciences Laboratory II	0	0	2	1	II
9.	20MAT33	Linear Algebra and Transforms	3	1	0	4	III
10.	20MAT43	Probability Theory and Stochastic Process	3	1	0	4	IV
<b>Total Credits to be earned</b>						<b>30</b>	

<b>ENGINEERING SCIENCE (ES)</b>							
<b>S. No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Sem</b>
1.	20ECT11	Basics of Electrical Engineering	3	0	0	3	I
2.	20ECL11	Basics of Electrical Engineering Laboratory	0	0	2	1	I
3.	20MEC11	Engineering Drawing	2	0	2	3	II
4.	20MEL11	Engineering Practices Laboratory	0	0	2	1	II
5.	20CSC31	Programming in C *	3	0	2	4	III/II
6.	20CSC41	Python Programming *	3	0	2	4	IV/III
7.	20ECT43	Control Engineering	3	1	0	4	IV
<b>Total Credits to be earned</b>						<b>20</b>	

<b>PROFESSIONAL CORE (PC)</b>								
<b>S. No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Sem</b>	<b>Domain/Stream</b>
1.	20ECT12	Circuit Theory and Network Analysis	3	1	0	4	I	EL
2.	20ECT21	Electromagnetic Fields *	3	1	0	4	II/III	CN
3.	20ECT31	Digital Electronics	3	0	0	3	III	VD
4.	20ECT32	Solid State Devices and Circuits	3	0	0	3	III	EL



5.	20ECT33	Signals and Systems *	3	1	0	4	III/IV	SIP
6.	20ECL31	Digital Electronics Laboratory	0	0	2	1	III	VD
7.	20ECL32	Solid State Devices and Circuits Laboratory	0	0	2	1	III	EL
8.	20ECT41	Electronic Circuits	3	0	0	3	IV	EL
9.	20ECT42	Microprocessor and Microcontroller	3	0	0	3	IV	ES
10.	20ECL41	Electronic Circuits Laboratory	0	0	2	1	IV	EL
11.	20ECL42	Microprocessor and Microcontroller Laboratory	0	0	2	1	IV	ES
12.	20ECT51	Analog and Digital Communication	3	0	0	3	V	CN
13.	20ECT52	Digital Signal Processing	3	0	0	3	V	SIP
14.	20ECT53	Linear Integrated Circuits	3	0	0	3	V	EL
15.	20ECL51	Analog and Digital Communication Laboratory	0	0	2	1	V	CN
16.	20ECL52	Digital Signal Processing Laboratory	0	0	2	1	V	SIP
17.	20ECL53	Linear Integrated Circuits Laboratory	0	0	2	1	V	EL
18.	20ECT61	VLSI Design	3	0	0	3	VI	VD
19.	20ECT62	Data Communication and Networking	3	0	0	3	VI	CN
20.	20ECT63	Microwave and Optical Communication	3	0	0	3	VI	CN
21.	20ECL61	VLSI Design Laboratory	0	0	2	1	VI	VD
22.	20ECL62	Data Communication and Networking Laboratory	0	0	2	1	VI	CN
23.	20ECL63	Microwave and Optical Communication Laboratory	0	0	2	1	VI	CN
24.	20ECT71	Antennas and Wave Propagation	3	0	2	4	VII	CN
<b>Total Credits to be earned</b>						<b>56</b>		

\* 2020-2021/2021-2022 admitted

PROFESSIONAL ELECTIVE COURSES								
S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/Stream
<b>Elective 1</b>								
1.	20ECE01	Transmission Lines and Waveguides	3	0	0	3	V	CN
2.	20ECE02	Microcontroller Based Automation	2	0	2	3	V	ES
3.	20ECE03	Medical Electronics	3	0	0	3	V	EL
4.	20ECE04	Computer Architecture and Interfacing	3	0	0	3	V	EL
5.	20ECE05	OptoElectronics	3	0	0	3	V	EL
6.	20ECE06	Soft Computational Techniques	3	0	0	3	V	SIP
7.	20ECE07	Linux Operating Systems	2	0	0	2	V	SD



		<b>Elective 2</b>						
8.	20ECE08	Mobile Communication	3	0	0	3	VII	CN
9.	20ECE09	Embedded Systems Design	3	0	0	3	VII	ES
10.	20ECE10	Modern Electronic Instrumentation	3	0	0	3	VII	EL
11.	20ECE11	Electronics Circuit Board Design	2	0	2	3	VII	EL
12.	20ECE12	Digital Image Processing	3	0	0	3	VII	SIP
13.	20ECE13	ASIC Design	3	0	0	3	VII	VD
14.	20ECE14	Network Information Security	3	0	0	3	VII	CN
		<b>Elective 3</b>						
15.	20ECE15	Wireless Broadband Communication	3	0	0	3	VII	CN
16.	20ECE16	Embedded IoT	3	0	0	3	VII	ES
17.	20ECE17	DSP Processor and its Applications	3	0	0	3	VII	SIP
18.	20ECE18	Wavelet Transform and its Applications	3	0	0	3	VII	SIP
19.	20ECE19	Testing and Fault Diagnosis of VLSI Circuits	3	0	0	3	VII	VD
20.	20ECE20	Computer Vision	3	0	0	3	VII	SD
21.	20ECE21	MEMS Design	3	0	0	3	VII	VD
22.	20GEE01	Fundamentals of research	3	0	0	3	VII	
		<b>Elective 4</b>						
23.	20ECE22	Satellite Communication	3	0	0	3	VII	CN
24.	20ECE23	Wireless Networks	3	0	0	3	VII	CN
25.	20ECE24	Real Time Operating system	3	0	0	3	VII	ES
26.	20ECE25	Deep Learning and its Applications	3	0	0	3	VII	SIP
27.	20ECE26	System Verilog	3	0	0	3	VII	VD
28.	20ECE27	Natural Language Processing	3	0	0	3	VII	SD
29.	20ECE28	Industry 4.0	3	0	0	3	VII	ES
		<b>Elective 5</b>						
30.	20ECE29	Next Generation Wireless Communication Systems	3	0	0	3	VII	CN
31.	20ECE30	Cyber Physical Systems	3	0	0	3	VII	ES
32.	20ECE31	Automotive Electronic Systems	3	0	0	3	VII	EL
33.	20ECE32	Principles of Machine Learning	3	0	0	3	VII	SIP
34.	20ECE33	Nanotechnology For Energy Sustainability	2	0	2	3	VII	VD
35.	20ECE34	Software Quality Assurance and Testing	3	0	0	3	VII	SD
		<b>Elective 6</b>						



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36.	20ECE35	Radar Engineering	3	0	0	3	VIII	CN
37.	20ECE36	RF Communications	3	0	0	3	VIII	CN
38.	20ECE37	RISC Architecture	3	0	0	3	VIII	ES
39.	20ECE38	Remote Sensing	3	0	0	3	VIII	SIP
40.	20ECE39	Computer Design Automation for VLSI Circuits	3	0	0	3	VIII	VD
41.	20ECE40	Blockchain Technologies	3	0	0	3	VIII	SD
42.	20ECE41	Quantum Computing and Information	3	0	0	3	VIII	VD
Total Credits to be earned						18		

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20GEL51/ 20GEI 51	Professional Skills Training I / Industrial Training I	0	0	0	2	V
2.	20GEL61/ 20GEI 61	Professional Skills Training II / Industrial Training II	0	0	0	2	VI
3.	20GEP61	Comprehensive Test and Viva	0	0	0	2	VI
4.	20ECP61	Project Work I	0	0	4	2	VI
5.	20ECP71	Project Work II Phase I	0	0	6	3	VII
6.	20ECP81	Project Work II Phase II	0	0	14	7	VIII
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

**OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)**  
(Common to all departments except offering department)

S.No.	Course Code	Course Title	Hours/Week			Credit	Sem
			L	T	P		
1	20ECO01	Wearable Technology	3	1	0	4	IV
2	20ECO02	Basics of Electronics in Automation Appliances	3	1	0	4	IV
3	20ECO03	Principles of Quantum Computing	3	0	2	4	IV
4	20ECO04	PCB Design and Fabrication	3	0	2	4	V
5	20ECO05	Electronic Hardware and Troubleshooting	2	0	2	3	VI
6	20ECO06	Bioinspired Computing Technologies	2	0	2	3	VI
7	20ECO07	Optical Engineering	3	0	0	3	VIII

**OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)**

S.No.	Course Code	Course Title	L	T	P	C	Offering Dept.
		<b>SEMESTER - IV</b>					



1	20CEO01	Remote Sensing and its Applications	3	0	2	4	CIVIL
2	20MEO01	Renewable Energy Sources	3	0	2	4	MECH
3	20MTO01	Design of Mechatronics Systems	3	1	0	4	MTS
4	20AUO01	Automotive Engineering	3	0	2	4	AUTO
8	20EEO01	Solar and Wind Energy Systems	3	1	0	4	EEE
9	20EEO02	Electrical Wiring and Lighting	3	1	0	4	EEE
10	20EEO03	Electrical Safety	3	1	0	4	EEE
11	20EIO01	Digital Image Processing and Its Applications	3	1	0	4	EIE
12	20CSO01	Fundamentals of Databases	3	0	2	4	CSE
13	20CSO02	Python Programming and Frameworks	3	0	2	4	CSE
14	20ITO01	Artificial Intelligence	3	1	0	4	IT
15	20ITO02	Web Technologies	3	1	0	4	IT
16	20ITO03	Introduction to Operating Systems	3	1	0	4	IT
17	20ITO04	Programming in Python	3	1	0	4	IT
18	20CHO01	Drugs and Pharmaceuticals Technology	3	1	0	4	CHEM
19	20CHO02	Process Automation	3	1	0	4	CHEM
20	20FTO01	Baking Technology	3	0	2	4	FT
21	20FTO02	Food Processing Technology	3	1	0	4	FT
22	20CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD
23	20ADO01	Data Warehousing and Data Mining	3	0	2	4	AIDS
24	20ALO01	Business Intelligence	3	1	0	4	AIML
25	20PHO01	Thin Film Technology	3	1	0	4	PHY
26	20CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMIS
		<b>SEMESTER - V</b>					
27	20CEO02	Disaster Management	3	1	0	4	CIVIL
28	20MEO02	Design of Experiments	3	0	2	4	MECH
29	20MTO02	Factory Automation	3	0	2	4	MTS
30	20MTO03	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
31	20AUO02	Automotive Electronics	3	0	2	4	AUTO
33	20EEO04	Energy Conservation and Management	3	1	0	4	EEE
34	20EIO02	Industrial Automation	3	1	0	4	EIE
35	20EIO03	Measurements and Instrumentation	3	1	0	4	EIE
36	20CSO03	Computational Science for Engineers	3	1	0	4	CSE
37	20CSO04	Formal Languages and Automata	3	1	0	4	CSE
38	20ITO05	Data Science	3	1	0	4	IT
39	20ITO06	Advanced Java Programming	3	1	0	4	IT
40	20CHO03	Renewable Bioenergy Resources	3	1	0	4	CHEM



41	20CHO04	Intelligent Controllers	3	1	0	4	CHEM
42	20FTO03	Processing of Milk and Milk Products	3	0	2	4	FT
43	20FTO04	Processing of Fruits and Vegetables	3	0	2	4	FT
44	20CDO02	Fundamentals of User Interactive Design	3	0	2	4	CSD
45	20ADO02	Computer Vision	3	0	2	4	AIDS
46	20ALO02	Data Exploration and Visualization Techniques	3	0	2	4	AIML
47	20PHO02	High Energy Storage Devices	3	0	0	3	PHY
48	20CYO02	Corrosion Science and Engineering	3	1	0	4	CHEMIS
49	20CYO03	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMIS
50	20CYO04	Chemistry of Nutrition for Women Health	3	1	0	4	CHEMIS
51	20MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
52	20MAO02	Graph Theory and its Applications	3	1	0	4	MATHS
		<b>SEMESTER - VI</b>					
53	20CEO03	Introduction to Smart Cities	3	0	0	3	CIVIL
54	20CEO04	Environmental Health and Safety	3	0	0	3	CIVIL
55	20MEO03	Fundamentals of Ergonomics	3	0	0	3	MECH
56	20MEO04	Principles of Management and Industrial Psychology	3	0	0	3	MECH
57	20MTO04	3D Printing and Design	3	0	0	3	MTS
58	20MTO05	Drone System Technology	3	0	0	3	MTS
59	20MTO06	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS
60	20AUO03	Vehicle Maintenance	3	0	0	3	AUTO
63	20EEO05	Micro Grid and Smart Grid	3	0	0	3	EEE
64	20EEO06	E-Waste Management	3	0	0	3	EEE
65	20EIO04	Biomedical Instrumentation and Applications	3	0	0	3	EIE
66	20EIO05	PLC Programming and Its Applications	3	0	0	3	EIE
67	20EIO06	Instrumentation for Industry 4.0	3	0	0	3	EIE
68	20CSO05	Java Programming	2	0	2	3	CSE
69	20CSO06	Web Engineering	2	0	2	3	CSE
70	20CSO07	Nature Inspired Optimization Techniques	3	0	0	3	CSE
71	20ITO07	Bio Natural Language Processing	3	0	0	3	IT
72	20ITO08	Disaster Management for Information Technology	3	0	0	3	IT
73	20CHO05	Food as Medicine	3	0	0	3	CHEM
74	20CHO06	Organic Farming	3	0	0	3	CHEM
75	20FTO05	Principles of Food Safety	3	0	0	3	FT
76	20FTO06	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
77	20CDO03	Introduction to Mobile Game Design	3	0	0	3	CSD
78	20ADO03	Neural Networks and Deep Learning	3	0	0	3	AIDS



79	20ALO03	Industrial Machine Learning	3	0	0	3	AIML
80	20PHO03	Structural and Optical Characterization of Materials	3	0	0	3	PHY
81	20CYO05	Chemistry Concepts for Competitive Examinations	3	0	0	3	CHEMIS
82	20CYO06	Waste and Hazardous Waste Management	3	0	0	3	CHEMIS
83	20MAO03	Data Analytics using R Programming	3	0	2	4	MATHS
84	20MAO04	Number Theory and Cryptography	3	1	0	4	MATHS
<b>SEMESTER - VIII</b>							
85	20CEO05	Infrastructure Planning and Management	3	0	0	3	CIVIL
86	20CEO06	Environmental Laws and Policy	3	0	0	3	CIVIL
87	20MEO05	Safety Measures for Engineers	3	0	0	3	MECH
88	20MEO06	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
89	20MTO06	Robotics	3	0	0	3	MTS
90	20MTO07	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS
91	20AUO04	Public Transport Management	3	0	0	3	AUTO
92	20AUO05	Autonomous Vehicles	3	0	0	3	AUTO
94	20EEO07	Electric Vehicle	3	0	0	3	EEE
95	20EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	EIE
96	20EIO08	Testing of Materials	3	0	0	3	EIE
97	20CSO08	Fundamentals of Internet of Things	3	0	0	3	CSE
98	20CSO09	Machine Translation	3	0	0	3	CSE
99	20CSO10	Fundamentals of Blockchain	3	0	0	3	CSE
100	20ITO09	Modern Application Development	3	0	0	3	IT
101	20ITO10	Object Oriented System Development using UML	3	0	0	3	IT
102	20ITO11	Reinforcement Learning	3	0	0	3	IT
103	20CHO07	Cosmetics and Personal Health Care Products	3	0	0	3	CHEM
104	20CHO08	Brewing and Alcohol Technology	3	0	0	3	CHEM
105	20FTO07	Food Ingredients	3	0	0	3	FT
106	20FTO08	Food and Nutrition	3	0	0	3	FT
107	20CDO04	Introduction to Graphics Design	3	0	0	3	CSD
108	20ADO04	Business Analytics	3	0	0	3	AIDS
109	20ALO04	Machine Learning for Smart Cities	3	0	0	3	AIML
110	20MAO05	Advanced Linear Algebra	3	0	0	3	MATHS
111	20MAO06	Optimization Techniques	3	0	0	3	MATHS

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

S.No.	Course Code	Course Title	L	T	P	C	Offering Dept.	Semester
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1.	20GEO03	Design Thinking for Engineers	3	1	0	4	V	CSE
2.	20GEO04	Innovation and Business Model Development	3	1	0	4	VI	MTS
3.	20GEO11	NCC Studies (Army Wing) - I	3	0	2	4	V/VI	EEE
4.	20GEO12	NCC Studies (Air Wing) - I	3	0	2	4	V/VI	IT
5.	20GEO19	Entrepreneurship Development	3	0	0	3	VIII	MTS
6.	20GEO01	German Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
7.	20GEO02	Japanese Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
8.	20GEO05	German Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
9.	20GEO06	German Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
10.	20GEO07	German Language Level 4	3	0	0	3	IV/V/VII/VIII	ECE
11.	20GEO08	Japanese Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
12.	20GEO09	Japanese Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
13.	20GEO10	Japanese Language Level 4	3	0	0	3	IV/V/VII/VIII	ECE
14.	20GEO13	French Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
15.	20GEO14	French Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
16.	20GEO15	French Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
17.	20GEO16	Spanish Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
18.	20GEO17	Spanish Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
19.	20GEO18	Spanish Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE

**KEC R2018: SCHEDULING OF COURSES – BE (Electronics and Communication Engineering)**
**Total Credits :169**

Sem	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	20EGT11 English Language Skills (3-0-0-3)	20MAC11 Matrices and Differential Equations (3-1*-2*-4)	20PHT11 Applied Physics (3-0-0-3)	20CYT11 Applied Chemistry (3-0-0-3)	20ECT11 Basics of Electrical Engineering (3-0-0-3)	20ECT12 Circuit Theory and Network Analysis (3-1-0-4)	20ECL11 Basics of Electrical Engineering Laboratory (0-0-2-1)	20PHL11 Physical Sciences Laboratory I (0-0-2-1)	20MNT11 Induction Training Program (-- --0)		22
II	20EGT21 Advanced Communication Skills (3-0-0-3)	20MAC21 Multivariable Calculus and Complex Analysis (3-1*-2*-4)	20PHT23 Physics for Communication and Computer Science Engineering (3-0-0-3)	20CYT23 Chemistry of Electronic Materials (3-0-0-3)	20MEC11 Engineering Drawing (2-0-2-3)	20ECT21 Electromagnetic Fields (3-1-0-4)	20MEL11 Engineering Practices Laboratory (0-0-2-1))	20PHL24 Physical Sciences Laboratory II(0-0-2-1)	20VEC11 Yoga Values for Holistic Development(1-0-1-1)		23
III	20MAT33 Linear Algebra and Transforms (3-1-0-4)	20CSC31 Programming in C(2020-2021 (3-0-2-4)	20ECT31 Digital Electronics (3-0-0-3)	20ECT32 Solid State Devices and Circuits (3-0-0-3)	20ECT33 Signals and Systems (3-1-0-4)	20ECL31 Digital Electronics Laboratory (0-0-2-1)	20ECL32 Solid State Devices and Circuits Laboratory (0-0-2-1)	20EGL31 English for Workplace Communication Laboratory (0-0-2-1)	20GET31 Universal Human Values(2-0-0-2)		23
IV	20MAT43 Probability Theory and Stochastic Process (3-1-0-4)	20CSC41 Python Programming (3-0-2-4)	20ECT41 Electronic Circuits (3-0-0-3)	20ECT42 Microprocessor and Microcontroller (3-0-0-3)	20ECT43 Control Engineering (3-1-0-4)	Open Elective I (3-1-0-4) (3-0-2-4)	20ECL42 Electronic Circuits Laboratory (0-0-2-1)	20ECL42 Microprocessor and Microcontroller Laboratory (0-0-2-1)	20MNT31 Environmental Science (2-0-0-0)		24
V	20ECT51 Analog and Digital Communication (3-0-0-3)	20ECT52 Digital Signal Processing (3-0-0-3)	20ECT53 Linear Integrated Circuits (3-0-0-3)	Professional Elective I (3-0-0-3)	Open Elective II (3-1/0-0/2-4)	20ECL51 Analog and Digital Communication Lab (0-0-2-1)	20ECL52 Digital Signal Processing Laboratory (0-0-2-1)	20ECL53 Linear Integrated Circuits Laboratory (0-0-2-1)	20GEL51 Professional Skills Training I (0-0-0-2)		21
VI	20ECT61 VLSI Design (3-0-0-3)	20ECT62 Data Communication and Networking (3-0-0-3)	20ECT63 Microwave and Optical Communication (3-0-0-3)	Open Elective III (3-0-0-3)	20ECL61 VLSI Design Laboratory (0-0-2-1)	20ECL62 Data Communication and Internet working Lab (0-0-2-1)	20ECL63 Microwave and Optical Communication Lab (0-0-2-1)	20GEL61/ 20GEI61 Professional Skills Training II (0-0-0-2)	20GEP61 Comprehensive Test / Viva (0-0-0-2)	20ECP61 Project Work I (0-0-4-2)	21
VII	20GET71 Engineering Economics and Management (3-0-0-3)	20ECT71 Antennas and Wave Propagation (3-0-2-4)	Professional Elective II (3-0-0-3)	Professional Elective III (3-0-0-3)	Professional Elective IV (3-0-0-3)	Professional Elective V (3-0-0-3)	20ECP71 Project Work II Phase I (0-0-6-3)				22
VIII	Professional Elective VI (3-0-0-3)	Open Elective IV (3-0-0-3)	20ECP81 Project Work II Phase II (0-0-14-7)								13

### MAPPING OF COURSES WITH POs AND PSOs

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	20EGT11	English Language Skills						✓			✓	✓	✓	✓		
1	20MAC11	Matrices and Differential Equations	✓	✓	✓	✓	✓									
1	20PHT11	Applied Physics	✓	✓	✓											
1	20CYT11	Applied Chemistry	✓	✓	✓	✓										
1	20ECT11	Basics of Electrical Engineering	✓	✓	✓	✓									✓	✓
1	20ECT12	Circuit Theory and Network Analysis	✓	✓	✓	✓									✓	
1	20ECL11	Basics of Electrical Engineering Laboratory	✓	✓	✓	✓	✓								✓	✓
1	20PHL11	Physical Sciences Laboratory I				✓										
2	20EGT21	Advanced Communication Skills						✓			✓	✓	✓	✓		
2	20MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	20PHT23	Physics for Communication and Computer Science Engineering	✓	✓	✓											
2	20CYT23	Chemistry of Electronic Materials	✓	✓	✓	✓										
2	20MEC11	Engineering Drawing	✓	✓	✓	✓						✓	✓	✓	✓	✓
2	20ECT21	Electromagnetic Fields	✓	✓	✓	✓									✓	
2	20MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓		
2	20PHL24	Physical Sciences Laboratory II			✓											
2	20VEC11	Yoga Values for Holistic Development						✓		✓	✓			✓		
3	20MAT33	Linear Algebra and Transforms	✓	✓	✓										✓	
3	20CSC31	Programming in C	✓	✓	✓	✓	✓				✓	✓		✓		
3	20ECT31	Digital Electronics	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	20ECT32	Solid State Devices and Circuits	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓
3	20ECT33	Signals and Systems	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	
3	20ECL31	Digital Electronics Laboratory	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓



Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	20ECL32	Solid State Devices and Circuits Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
3	20EGL31	English for Workplace Communication Laboratory									✓	✓		✓		
3	20GET31	Universal Human Values						✓	✓	✓	✓	✓				
4	20MAT43	Probability Theory and Stochastic Process	✓	✓	✓	✓										
4	20CSC41	Python Programming	✓	✓	✓	✓										
4	20ECT41	Electronic Circuits	✓	✓	✓	✓		✓		✓				✓	✓	✓
4	20ECT42	Microprocessor and Microcontroller	✓	✓				✓				✓		✓	✓	✓
4	20ECT43	Control Engineering	✓	✓	✓	✓	✓				✓	✓		✓	✓	
4	20ECL41	Electronic Circuits Laboratory	✓	✓	✓	✓	✓				✓				✓	✓
4	20ECL42	Microprocessor and Microcontroller Laboratory	✓		✓						✓	✓		✓	✓	
4	20MNT31	Environmental Science	✓	✓	✓				✓					✓	✓	✓
5	20ECT51	Analog and Digital Communication	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	
5	20ECT52	Digital Signal Processing	✓	✓	✓	✓	✓				✓				✓	✓
5	20ECT53	Linear Integrated Circuits	✓	✓	✓	✓	✓	✓						✓	✓	✓
5	20ECL51	Analog and Digital Communication Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	
5	20ECL52	Digital Signal Processing Laboratory	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓
5	20ECL53	Linear Integrated Circuits Laboratory	✓	✓	✓	✓	✓	✓			✓	✓			✓	✓
5	20GEL51	Professional Skills Training I	✓	✓				✓	✓		✓	✓	✓	✓		
6	20ECT61	VLSI Design	✓	✓	✓					✓				✓		✓
6	20ECT62	Data Communication and Networking	✓	✓	✓	✓								✓	✓	✓
6	20ECT63	Microwave and Optical Communication	✓	✓	✓		✓	✓	✓				✓	✓	✓	
6	20ECL61	VLSI Design Laboratory	✓	✓			✓				✓			✓	✓	✓
6	20ECL62	Data Communication and Networking Laboratory	✓	✓	✓	✓		✓			✓	✓		✓	✓	
6	20ECL63	Microwave and Optical Communication Laboratory	✓	✓	✓		✓				✓		✓	✓	✓	✓



Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20GEL61	Professional Skills Training II	✓	✓				✓	✓		✓	✓	✓	✓		
6	20GEP61	Comprehensive Test / Viva	✓	✓	✓	✓						✓	✓	✓	✓	✓
6	20ECP61	Project Work I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20GET71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20ECT71	Antennas and Wave Propagation	✓	✓			✓				✓				✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		<b>Professional Electives</b>														
5	20ECE01	Transmission Lines and Waveguides	✓	✓						✓					✓	
5	20ECE02	Microcontroller Based Automation	✓		✓	✓	✓			✓	✓		✓	✓	✓	✓
5	20ECE03	Medical Electronics	✓	✓				✓							✓	
5	20ECE04	Computer Architecture and Interfacing	✓	✓	✓	✓										✓
5	20ECE05	OptoElectronics	✓	✓	✓									✓		
5	20ECE06	Soft Computational Techniques	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	20ECE07	Linux Operating Systems	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
6	20ECE08	Mobile Communication	✓	✓	✓		✓									
6	20ECE09	Embedded Systems Design	✓	✓	✓	✓	✓							✓	✓	✓
6	20ECE10	Modern Electronic Instrumentation	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓
6	20ECE11	Electronics Circuit Board Design	✓	✓	✓		✓				✓	✓		✓	✓	✓
6	20ECE12	Digital Image Processing	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	20ECE13	ASIC Design	✓	✓				✓	✓	✓				✓		✓
6	20ECE14	Network Information Security	✓	✓	✓	✓				✓					✓	
7	20ECE15	Wireless Broadband Communication	✓	✓	✓	✓	✓					✓	✓	✓	✓	
7	20ECE16	Embedded IoT	✓	✓			✓				✓	✓	✓	✓	✓	✓
7	20ECE17	DSP Processor and its Applications	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	



7	20ECE18	Wavelet Transform and its Applications	✓	✓	✓	✓		✓		✓		✓			✓	
7	20ECE19	Testing and Fault Diagnosis of VLSI Circuits	✓	✓			✓			✓				✓	✓	✓
7	20ECE20	Computer Vision	✓	✓			✓				✓			✓	✓	✓
7	20ECE21	MEMS Design	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓
7	20GEE01	Fundamentals of research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20ECE22	Satellite Communication	✓	✓	✓	✓				✓				✓	✓	✓
7	20ECE23	Wireless Networks	✓	✓	✓	✓		✓							✓	✓
7	20ECE24	Real Time Operating system	✓	✓			✓				✓	✓	✓	✓	✓	✓
7	20ECE25	Deep Learning and its Applications	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓	✓
7	20ECE26	System Verilog	✓	✓	✓	✓				✓				✓		✓
7	20ECE27	Natural Language Processing	✓	✓	✓	✓	✓									
7	20ECE28	Industry 4.0	✓	✓	✓	✓	✓		✓						✓	✓
7	20ECE29	Next Generation Wireless Communication Systems	✓	✓	✓	✓						✓	✓	✓	✓	
7	20ECE30	Cyber Physical Systems	✓	✓				✓		✓					✓	
7	20ECE31	Automotive Electronic Systems	✓	✓			✓	✓	✓	✓				✓	✓	
7	20ECE32	Principles of Machine Learning	✓	✓			✓				✓			✓	✓	
7	20ECE33	Nanotechnology For Energy Sustainability	✓	✓	✓		✓		✓				✓			✓
7	20ECE34	Software Quality Assurance and Testing	✓	✓			✓			✓			✓	✓	✓	
8	20ECE35	Radar Engineering	✓	✓	✓			✓						✓	✓	
8	20ECE36	RF Communications	✓	✓	✓			✓					✓	✓	✓	
8	20ECE37	RISC Architecture	✓	✓			✓				✓	✓	✓	✓	✓	✓
8	20ECE38	Remote Sensing	✓	✓			✓	✓	✓		✓	✓		✓	✓	✓
8	20ECE39	Computer Design Automation for VLSI Circuits	✓	✓	✓	✓	✓							✓	✓	
8	20ECE40	Blockchain Technologies	✓	✓			✓								✓	
8	20ECE41	Quantum Computing and Information	✓	✓	✓		✓	✓						✓	✓	✓



		Open Elective Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
4	20CEO01	Remote Sensing and its Applications	✓	✓	✓	✓		✓			✓			✓		
4	20MEO01	Renewable Energy Sources	✓	✓		✓			✓		✓	✓				
4	20MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
4	20AUO01	Automotive Engineering	✓	✓	✓		✓				✓	✓				
4	20ECO01	Wearable Technology	✓	✓	✓	✓		✓		✓				✓		
4	20ECO02	Basics of Electronics in Automation Appliances	✓	✓	✓	✓		✓	✓	✓			✓	✓		
4	20ECO03	Principles of Quantum Computing	✓	✓	✓	✓	✓				✓	✓		✓		
4	20EEO01	Solar and Wind Energy Systems	✓	✓	✓				✓							
4	20EEO02	Electrical Wiring and Lighting	✓	✓	✓	✓	✓									
4	20EEO03	Electrical Safety	✓	✓	✓											
4	20EIO01	Digital Image Processing and Its Applications	✓	✓	✓	✓	✓									
4	20CSO01	Fundamentals of Databases	✓	✓	✓	✓	✓									
4	20CSO02	Python Programming and Frameworks														
4	20ITO01	Artificial Intelligence	✓	✓	✓	✓										
4	20ITO02	Web Technologies	✓	✓	✓											
4	20ITO03	Introduction to Operating Systems	✓	✓	✓	✓										
4	20ITO04	Programming in Python			✓		✓							✓		
4	20CHO01	Drugs and Pharmaceuticals Technology	✓	✓	✓	✓	✓									
4	20CHO02	Process Automation	✓	✓	✓		✓									
4	20FTO01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
4	20FTO02	Food Processing Technology	✓	✓	✓	✓								✓		
4	20CDO01	Fundamentals of User Experience Design	✓	✓	✓	✓					✓	✓	✓			
4	20ADO01	Data Warehousing and Data Mining	✓	✓	✓											

		Open Elective Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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4	20ALO01	Business Intelligence	✓	✓	✓											
4	20PHO01	Thin Film Technology	✓	✓	✓											
4	20CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										
5	20CEO02	Disaster Management	✓	✓	✓			✓	✓					✓		
5	20MEO02	Design of Experiments	✓	✓	✓	✓	✓						✓			
5	20MTO02	Factory Automation	✓	✓	✓	✓	✓	✓			✓	✓		✓		
5	20MTO03	Data Acquisition and Virtual Instrumentation	✓	✓	✓	✓	✓				✓	✓		✓		
5	20AUO02	Automotive Electronics	✓	✓	✓	✓	✓				✓	✓		✓		
5	20ECO04	PCB Design and Fabrication	✓	✓	✓		✓			✓	✓	✓		✓		
5	20EE004	Energy Conservation and Management	✓	✓	✓		✓									
5	20EIO02	Industrial Automation	✓	✓	✓	✓	✓									
5	20EIO03	Measurements and Instrumentation	✓	✓	✓	✓	✓									
5	20CSO03	Computational Science for Engineers	✓	✓	✓											
5	20CSO04	Formal Languages and Automata	✓	✓	✓											
5	20ITO05	Data Science	✓	✓	✓	✓										
5	20ITO06	Advanced Java Programming	✓	✓	✓											
5	20CHO03	Renewable Bioenergy Resources	✓	✓	✓	✓			✓							
5	20CHO04	Intelligent Controllers	✓		✓	✓		✓								
5	20FTO03	Processing of Milk and Milk Products	✓	✓	✓		✓	✓		✓	✓	✓		✓		
5	20FTO04	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
5	20CDO02	Fundamentals of User Interactive Design	✓	✓	✓											
5	20ADO02	Computer Vision	✓	✓	✓	✓	✓									
5	20ALO02	Data Exploration and Visualization Techniques	✓	✓	✓	✓	✓									
5	20PHO02	High Energy Storage Devices	✓	✓	✓											
5	20CYO02	Corrosion Science and Engineering	✓	✓	✓	✓										
5	20CYO03	Chemistry of Cosmetics in Daily Life	✓	✓	✓											





5	20CYO04	Chemistry of Nutrition for Women Health	✓	✓	✓											
5	20MAO01	Mathematical Foundations for Machine Learning	✓	✓		✓	✓									
5	20MAO02	Graph Theory and its Applications	✓	✓	✓											
6	20CEO03	Introduction to Smart Cities	✓	✓	✓											
6	20CEO04	Environmental Health and Safety	✓	✓	✓	✓										
6	20MEO03	Fundamentals of Ergonomics	✓	✓	✓	✓	✓	✓	✓					✓		
6	20MEO04	Principles of Management and Industrial Psychology						✓		✓	✓	✓	✓			
6	20MTO04	3D Printing and Design	✓	✓	✓	✓	✓						✓	✓		
6	20MTO05	Drone System Technology	✓	✓	✓	✓	✓						✓	✓		
6	20MTO06	Virtual and Augment Reality in Industry 4.0														
6	20AUO03	Vehicle Maintenance	✓	✓	✓	✓								✓		
6	20ECO05	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓								
6	20ECO06	Bioinspired Computing Technologies	✓	✓	✓		✓				✓					
6	20EEO05	Micro Grid and Smart Grid	✓	✓	✓	✓										
6	20EEO06	E-Waste Management	✓	✓	✓	✓										
6	20EIO04	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓								
6	20EIO05	PLC Programming and Its Applications	✓	✓	✓	✓	✓									
6	20EIO06	Instrumentation for Industry 4.0	✓	✓	✓	✓	✓									
6	20CSO05	Java Programming	✓	✓	✓	✓	✓									
6	20CSO06	Web Engineering	✓	✓	✓	✓	✓									
6	20CSO07	Nature Inspired Optimization Techniques	✓	✓	✓											
6	20ITO07	Bio Natural Language Processing	✓	✓	✓	✓										
6	20ITO08	Disaster Management for Information Technology	✓	✓	✓	✓										
6	20CHO05	Food as Medicine	✓	✓	✓	✓		✓						✓		
6	20CHO06	Organic Farming	✓		✓			✓	✓	✓	✓		✓	✓		



6	20FTO05	Principles of Food Safety	✓	✓	✓		✓	✓	✓	✓				✓		
6	20FTO06	Fundamentals of Food Packaging and Storage	✓	✓	✓		✓	✓		✓				✓		
6	20CDO03	Introduction to Mobile Game Design	✓	✓	✓											
6	20ADO03	Neural Networks and Deep Learning	✓	✓	✓											
6	20ALO03	Industrial Machine Learning	✓	✓	✓											
6	20PHO03	Structural and Optical Characterization of Materials	✓	✓	✓											
6	20CYO05	Chemistry Concepts for Competitive Examinations	✓	✓	✓											
6	20CYO06	Waste and Hazardous Waste Management	✓	✓	✓	✓			✓							
6	20MAO03	Data Analytics using R Programming	✓	✓	✓	✓	✓									
6	20MAO04	Number Theory and Cryptography	✓	✓	✓		✓									
8	20CEO05	Infrastructure Planning and Management	✓	✓	✓											
8	20CEO06	Environmental Laws and Policy	✓	✓	✓	✓										
8	20MEO05	Safety Measures for Engineers	✓			✓		✓	✓	✓						
8	20MEO06	Energy Conservation in Thermal Equipments	✓	✓												
8	20MTO06	Robotics	✓	✓	✓	✓	✓							✓		
8	20MTO07	Virtual and Augment Reality in Industry 4.0	✓	✓	✓	✓	✓	✓						✓		
8	20AUO04	Public Transport Management	✓	✓				✓	✓	✓	✓	✓	✓	✓		
8	20AUO05	Autonomous Vehicles	✓	✓	✓											
8	20ECO07	Optical Engineering	✓	✓	✓	✓		✓		✓	✓			✓		
8	20EEO07	Electric Vehicle	✓	✓	✓	✓										
8	20EIO07	Graphical Programming using Virtual Instrumentation	✓	✓	✓	✓	✓									
8	20EIO08	Testing of Materials	✓	✓	✓	✓	✓									
8	20CSO08	Fundamentals of Internet of Things	✓	✓	✓		✓									
8	20CSO09	Machine Translation	✓	✓	✓											
8	20CSO10	Fundamentals of Blockchain	✓	✓	✓											



8	20ITO09	Modern Application Development	✓	✓	✓	✓										
8	20ITO10	Object Oriented System Development using UML	✓	✓	✓	✓										
8	20ITO11	Reinforcement Learning	✓	✓	✓	✓										
8	20CHO07	Cosmetics and Personal Health Care Products	✓		✓			✓		✓				✓		
8	20CHO08	Brewing and Alcohol Technology	✓	✓												
8	20FTO07	Food Ingredients	✓	✓	✓			✓						✓		
8	20FTO08	Food and Nutrition	✓	✓	✓			✓						✓		
8	20CDO04	Introduction to Graphics Design	✓	✓	✓											
8	20ADO04	Business Analytics	✓	✓	✓											
8	20ALO04	Machine Learning for Smart Cities	✓	✓	✓											
8	20MAO05	Advanced Linear Algebra	✓	✓	✓											
8	20MAO06	Optimization Techniques	✓	✓	✓											
5	20GEO03	Design Thinking for Engineers	✓	✓	✓											
6	20GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
4,5,6,8	20GEO11	NCC Studies (Army Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
4,5,6,8	20GEO12	NCC Studies (Air Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
8	20GEO19	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

**B.E. DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING  
CURRICULUM UNDER REGULATIONS 2020**

**(For the candidates admitted in the academic year 2020-21)**

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT11	English Language Skills	3	0	0	3	50	50	100	HS
20MAC11	Matrices and Differential Equations	3	1*	2*	4	50	50	100	BS
20PHT11	Applied Physics	3	0	0	3	50	50	100	BS
20CYT11	Applied Chemistry	3	0	0	3	50	50	100	BS
20ECT11	Basics of Electrical Engineering	3	0	0	3	50	50	100	ES
20ECT12	Circuit Theory and Network Analysis	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20ECL11	Basics of Electrical Engineering Laboratory	0	0	2	1	50	50	100	ES
20PHL11	Physical Sciences Laboratory I	0	0	2	1	50	50	100	BS
20MNT11	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									
20EGT21	Advanced Communication Skills	3	0	0	3	50	50	100	HS
20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
20PHT23	Physics for Communication and Computer Science Engineering	3	0	0	3	50	50	100	BS
20CYT23	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
20ECT21	Electromagnetic Fields	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
20PHL24	Physical Sciences Laboratory II	0	0	2	1	50	50	100	BS
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
Total Credits to be earned					23				

\*Alternate Weeks



**B.E. DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING  
CURRICULUM UNDER REGULATIONS 2020**

**(For the candidates admitted in the academic year 2020-21)**

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT33	Linear Algebra and Transforms	3	1	0	4	50	50	100	BS
20CSC31	Programming in C	3	0	2	4	50	50	100	ES
20ECT31	Digital Electronics	3	0	0	3	50	50	100	PC
20ECT32	Solid State Devices and Circuits	3	0	0	3	50	50	100	PC
20ECT33	Signals and Systems	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20ECL31	Digital Electronics Laboratory	0	0	2	1	50	50	100	PC
20ECL32	Solid State Devices and Circuits Laboratory	0	0	2	1	50	50	100	PC
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	50	50	100	HS
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					23				

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT43	Probability Theory and Stochastic Process	3	1	0	4	50	50	100	BS
20CSC41	Python Programming	3	0	2	4	50	50	100	ES
20ECT41	Electronic Circuits	3	0	0	3	50	50	100	PC
20ECT42	Microprocessor and Microcontroller	3	0	0	3	50	50	100	PC
20ECT43	Control Engineering	3	1	0	4	50	50	100	ES
	Open Elective I	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20ECL41	Electronic Circuits Laboratory	0	0	2	1	50	50	100	PC
20ECL42	Microprocessor and Microcontroller Laboratory	0	0	2	1	50	50	100	PC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Total Credits to be earned					24				



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**(For the candidates admitted in the academic year 2020-21)**

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ECT51	VLSI Design	3	0	0	3	50	50	100	PC
20ECT52	Digital Signal Processing	3	0	0	3	50	50	100	PC
20ECT53	Linear Integrated Circuits	3	0	0	3	50	50	100	PC
	Professional Elective I	3	0	0	3	50	50	100	PE
	Open Elective II	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20ECL51	VLSI Design Laboratory	0	0	2	1	50	50	100	PC
20ECL52	Digital Signal Processing Laboratory	0	0	2	1	50	50	100	PC
20ECL53	Linear Integrated Circuits Laboratory	0	0	2	1	50	50	100	PC
20GEL51/ 20GEI51	Professional Skills Training I / Industrial Training I	--	--	--	2	100	0	100	EC
Total Credits to be earned					21				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ECT61	Analog and Digital Communication	3	0	0	3	50	50	100	PC
20ECT62	Data Communication and Networking	3	0	0	3	50	50	100	PC
20ECT63	Microwave and Optical Communication	3	0	0	3	50	50	100	PC
	Open Elective III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20ECL61	Analog and Digital Communication Laboratory	0	0	2	1	50	50	100	PC
20ECL62	Data Communication and Networking Laboratory	0	0	2	1	50	50	100	PC
20ECL63	Microwave and Optical Communication Laboratory	0	0	2	1	50	50	100	PC
20GEL61/ 20GEI61	Professional Skills Training II / Industrial Training II	-	-	-	2	100	0	100	EC
20GEP61	Comprehensive Test and Viva	-	-	-	2	100	0	100	EC
20ECP61	Project Work I	0	0	4	2	100	0	100	EC
Total Credits to be earned					21				



**B.E. ELECTRONICS AND COMMUNICATION ENGINEERING CURRICULUM – R2020**  
**(For the candidates admitted in the academic year 2020-21)**

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20GET71	Engineering Economics and Management	3	0	0	3	50	50	100	HS
20ECT71	Antennas and Wave Propagation	3	0	2	4	50	50	100	PC
	Professional Elective II	3	0	0	3	50	50	100	PE
	Professional Elective III	3	0	0	3	50	50	100	PE
	Professional Elective IV	3	0	0	3	50	50	100	PE
	Professional Elective V	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20ECP71	Project Work II Phase I	0	0	12	6	50	50	100	EC
Total Credits to be earned					25				

SEMESTER – VII									
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	50	50	100	PE
	Open Elective IV	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20ECP81	Project Work II Phase II	--	--	8	4	50	50	100	EC
Total Credits to be earned					10				

**Total: 169**



**B.E. DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING**  
**CURRICULUM UNDER REGULATIONS 2020**  
 (with the inclusion of Amendment No.2022.18.07)

**(For the candidates admitted in the academic year 2021-22)**

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT11	English Language Skills	3	0	0	3	40	60	100	HS
20MAC11	Matrices and Differential Equations	3	1*	2*	4	50	50	100	BS
20PHT11	Applied Physics	3	0	0	3	40	60	100	BS
20CYT11	Applied Chemistry	3	0	0	3	40	60	100	BS
20ECT11	Basics of Electrical Engineering	3	0	0	3	40	60	100	ES
20ECT12	Circuit Theory and Network Analysis	3	1	0	4	40	60	100	PC
Practical / Employability Enhancement									
20ECL11	Basics of Electrical Engineering Laboratory	0	0	2	1	60	40	100	ES
20PHL11	Physical Sciences Laboratory I	0	0	2	1	60	40	100	BS
20MNT11	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									
20EGT21	Advanced Communication Skills	3	0	0	3	40	60	100	HS
20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
20PHT23	Physics for Communication and Computer Science Engineering	3	0	0	3	40	60	100	BS
20CYT23	Chemistry of Electronic Materials	3	0	0	3	40	60	100	BS
20MEC11	Engineering Drawing	2	0	2	3	40	60	100	ES
20CSC31	Programming in C	3	0	2	4	50	50	100	ES
Practical / Employability Enhancement									
20MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
20PHL24	Physical Sciences Laboratory II	0	0	2	1	60	40	100	BS
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
Total Credits to be earned					23				

\*Alternate Weeks





**B.E. DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING  
CURRICULUM UNDER REGULATIONS 2020**

**(For the candidates admitted in the academic year 2021-22)**

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT33	Linear Algebra and Transforms	3	1	0	4	40	60	100	BS
20CSC34	Data Structures using C	3	0	2	4	50	50	100	ES
20ECT31	Digital Electronics	3	0	0	3	40	60	100	PC
20ECT32	Solid State Devices and Circuits	3	0	0	3	40	60	100	PC
20ECT21	Electromagnetic Fields	3	1	0	4	40	60	100	PC
Practical / Employability Enhancement									
20ECL31	Digital Electronics Laboratory	0	0	2	1	60	40	100	PC
20ECL32	Solid State Devices and Circuits Laboratory	0	0	2	1	60	40	100	PC
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	60	40	100	HS
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
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									
20MAT43	Probability Theory and Stochastic Process	3	1	0	4	40	60	100	BS
20ECT33	Signals and Systems	3	1	0	4	40	60	100	PC
20ECT41	Electronic Circuits	3	0	0	3	40	60	100	PC
20ECT42	Microprocessor and Microcontroller	3	0	0	3	40	60	100	PC
20ECT43	Control Engineering	3	1	0	4	40	60	100	ES
	Open Elective I	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20ECL41	Electronic Circuits Laboratory	0	0	2	1	60	40	100	PC
20ECL42	Microprocessor and Microcontroller Laboratory	0	0	2	1	60	40	100	PC
20GEL51/ 20GEI51	Professional Skills Training I / Industrial Training I *	--	--	--	2	100	0	100	EC
Total Credits to be earned					26				

\* 80 hours of training



**B.E. DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING**  
**(For the candidates admitted in the academic year 2021-22)**

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ECT51	VLSI Design	3	0	0	3	40	60	100	PC
20ECT52	Digital Signal Processing	3	0	0	3	40	60	100	PC
20ECT53	Linear Integrated Circuits	3	0	0	3	40	60	100	PC
	Professional Elective I	3	0	0	3	40	60	100	PE
	Open Elective II	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20ECL51	VLSI Design Laboratory	0	0	2	1	60	40	100	PC
20ECL52	Digital Signal Processing Laboratory	0	0	2	1	60	40	100	PC
20ECL53	Linear Integrated Circuits Laboratory	0	0	2	1	60	40	100	PC
20GEL61/ 20GEI61	Professional Skills Training II / Industrial Training II *	-	-	-	2	100	0	100	EC
Total Credits to be earned					21				

\*80 hours of training

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ECT61	Analog and Digital Communication	3	0	0	3	40	60	100	PC
20ECT62	Data Communication and Networking	3	0	0	3	40	60	100	PC
20ECT63	Microwave and Optical Communication	3	0	0	3	40	60	100	PC
	Open Elective III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
20ECL61	Analog and Digital Communication Laboratory	0	0	2	1	60	40	100	PC
20ECL62	Data Communication and Networking Laboratory	0	0	2	1	60	40	100	PC
20ECL63	Microwave and Optical Communication Laboratory	0	0	2	1	60	40	100	PC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
20GEP61	Comprehensive Test and Viva	-	-	-	2	100	0	100	EC
20ECP61	Project Work I	0	0	4	2	100	0	100	EC
Total Credits to be earned					19				



**B.E. ELECTRONICS AND COMMUNICATION ENGINEERING CURRICULUM – R2020**  
**(For the candidates admitted in the academic year 2021-22)**

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20GET71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
20ECT71	Antennas and Wave Propagation	3	0	2	4	50	50	100	PC
	Professional Elective II	3	0	0	3	40	60	100	PE
	Professional Elective III	3	0	0	3	40	60	100	PE
	Professional Elective IV	3	0	0	3	40	60	100	PE
	Professional Elective V	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
20ECP71	Project Work II Phase I	0	0	12	6	50	50	100	EC
Total Credits to be earned					25				

SEMESTER – VII									
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									
20ECP81	Project Work II Phase II	--	--	8	4	50	50	100	EC
Total Credits to be earned					10				

**Total Credits : 169**



LIST OF PROFESSIONAL ELECTIVES						
Course code	Course Title	Hours/Week			Credit	Domain/ Stream
		L	T	P		
SEMESTER - 5						
Elective I						
20ECE01	Transmission Lines and Waveguides	3	0	0	3	CN
20ECE02	Microcontroller Based Automation	2	0	2	3	ES
20ECE03	Medical Electronics	3	0	0	3	EL
20ECE04	Computer Architecture and Interfacing	3	0	0	3	EL
20ECE05	OptoElectronics	3	0	0	3	EL
20ECE06	Soft Computational Techniques	3	0	0	3	SIP
20ECE07	Linux Operating Systems	2	0	2	3	SD
SEMESTER - 7						
Elective II						
20ECE08	Mobile Communication	3	0	0	3	CN
20ECE09	Embedded Systems Design	3	0	0	3	ES
20ECE10	Modern Electronic Instrumentation	3	0	0	3	EL
20ECE11	Electronics Circuit Board Design	2	0	2	3	EL
20ECE12	Digital Image Processing	3	0	0	3	SIP
20ECE13	ASIC Design	3	0	0	3	VD
20ECE14	Network Information Security	3	0	0	3	CN
Elective III						
20ECE15	Wireless Broadband Communication	3	0	0	3	CN
20ECE16	Embedded IoT	3	0	0	3	ES
20ECE17	DSP Processor and its Applications	3	0	0	3	SIP
20ECE18	Wavelet Transform and its Applications	3	0	0	3	SIP
20ECE19	Testing and Fault Diagnosis of VLSI Circuits	3	0	0	3	VD
20ECE20	Computer Vision	3	0	0	3	SD
20ECE21	MEMS Design	3	0	0	3	VD
20GEE01	Fundamentals of Research	3	0	0	3	
Elective IV						
20ECE22	Satellite Communication	3	0	0	3	CN
20ECE23	Wireless Networks	3	0	0	3	CN
20ECE24	Real Time Operating system	3	0	0	3	ES
20ECE25	Deep Learning and its Applications	3	0	0	3	SIP
20ECE26	System Verilog	3	0	0	3	VD
20ECE27	Natural Language Processing	3	0	0	3	SD
20ECE28	Industry 4.0	3	0	0	3	ES



<b>Elective V</b>						
20ECE29	Next Generation Wireless Communication Systems	3	0	0	3	CN
20ECE30	Cyber Physical Systems	3	0	0	3	ES
20ECE31	Automotive Electronic Systems	3	0	0	3	EL
20ECE32	Principles of Machine Learning	3	0	0	3	SIP
20ECE33	Nanotechnology For Energy Sustainability	2	0	2	3	VD
20ECE34	Software Quality Assurance and Testing	3	0	0	3	SD
<b>SEMESTER - 8</b>						
<b>Elective VI</b>						
20ECE35	Radar Engineering	3	0	0	3	CN
20ECE36	RF Communications	3	0	0	3	CN
20ECE37	RISC Architecture	3	0	0	3	ES
20ECE38	Remote Sensing	3	0	0	3	SIP
20ECE39	Computer Design Automation for VLSI Circuits	3	0	0	3	VD
20ECE40	Blockchain Technologies	3	0	0	3	SD
20ECE41	Quantum Computing and Information	3	0	0	3	VD

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

**OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS**

S.No.	Course Code	Course Title	Hours/Week			Credit	Sem
			L	T	P		
1	20ECO01	Wearable Technology	3	1	0	4	IV
2	20ECO02	Basics of Electronics in Automation Appliances	3	1	0	4	IV
3	20ECO03	Principles of Quantum Computing	3	0	2	4	IV
4	20ECO04	PCB Design and Fabrication	3	0	2	4	V
5	20ECO08	Image Processing	3	0	2	4	V
6	20ECO05	Electronic Hardware and Troubleshooting	2	0	2	3	VI
7	20ECO06	Bioinspired Computing Technologies	2	0	2	3	VI
8	20ECO07	Optical Engineering	3	0	0	3	VIII
9	20GEO01	German Language Level 1	4	0	0	4	IV/V/VII/VIII
10	20GEO02	Japanese Language Level 1	4	0	0	4	IV/V/VII/VIII
11	20GEO05	German Language Level 2	4	0	0	4	IV/V/VII/VIII
12	20GEO06	German Language Level 3	3	0	0	3	IV/V/VII/VIII
13	20GEO07	German Language Level 4	3	0	0	3	IV/V/VII/VIII
14	20GEO08	Japanese Language Level 2	4	0	0	4	IV/V/VII/VIII
15	20GEO09	Japanese Language Level 3	3	0	0	3	IV/V/VII/VIII
16	20GEO10	Japanese Language Level 4	3	0	0	3	IV/V/VII/VIII
17	20GEO13	French Language Level 1	4	0	0	4	IV/V/VII/VIII
18	20GEO14	French Language Level 2	4	0	0	4	IV/V/VII/VIII
19	20GEO15	French Language Level 3	3	0	0	3	IV/V/VII/VIII
20	20GEO16	Spanish Language Level 1	4	0	0	4	IV/V/VII/VIII
21	20GEO17	Spanish Language Level 2	4	0	0	4	IV/V/VII/VIII
22	20GEO18	Spanish Language Level 3	3	0	0	3	IV/V/VII/VIII



**20EGT11 - ENGLISH LANGUAGE SKILLS**  
(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at A2/B1 Level in the Common European Framework (CEFR).	
Unit - I	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – I</b>	<b>9</b>
Listening - Talking about past experiences - listening to descriptions - Speaking - Exchanging personal information - Talking about cities and transportation - Reading - Life and achievements of a famous personality - Global transport systems - Writing - Childhood experiences - Process Description – Grammar & Vocabulary – Past tense – Expressions of quantity – Indirect questions.		
Unit - II	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – II</b>	<b>9</b>
Listening - Information about hotels and accommodation - Recipes and food items - Speaking - Life style changes and making comparisons - Talking about food - Reading - Habit formation and changing habits - International cuisine - Writing - Personal email - emails about food and recipes – Grammar & Vocabulary – Evaluations and Comparisons with adjectives – Simple past and present perfect tenses.		
Unit - III	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – III</b>	<b>9</b>
Listening - Information about travel - descriptions / conversations about family life - Speaking - Vacations and Holidays - Requests, complaints and offering explanations - Reading - Tourist places and travel experiences - Group behaviour and politeness - Writing - Personal letter about travelling - Writing guidelines and checklists – Grammar & Vocabulary – Future tense – Modals – Two-part verbs.		
Unit - IV	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – IV</b>	<b>9</b>
Listening - Descriptions about festivals - Presentations on technology - Speaking - About technology - festivals, special events and traditions - Reading - Sports, hobbies and past time - About different cultures - Writing - Product Description - Writing web content – Grammar & Vocabulary – Infinitives and Gerunds for uses and purposes – Imperatives for giving suggestions – Relative clauses of time.		
Unit - V	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – V</b>	<b>9</b>
Listening - Talking about changes - Job preferences - Speaking - Comparing different periods or phases in life – Changes that happen - Skills and abilities, Personality Development - Employability Skills – Reading - Reading about life experiences - Emotions and feelings – Job preferences – Jobs and Personality – Writing - Writing about one's past, present and future – Researching job options – Choosing the right job – Grammar & Vocabulary – Time contrasts – Conditional sentences with “if clauses” – Gerunds – short responses.		

**Total: 45**

**TEXT BOOK:**

1.	Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student's Book 2”, 4 <sup>th</sup> Edition, Cambridge University Press, New York, 2017.
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**REFERENCES:**

1.	Sanjay Kumar and Pushp Lata, “Communication Skills”, 2 <sup>nd</sup> Edition, Oxford University Press, New Delhi, 2015.
2.	Pamela Hartmann and Brenda Wegmann, “New Interactions English Language Learning and Assessment Platform ( Level Intro - Level IV )”, McGraw Hill India, 2020.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	use language effectively and accurately acquiring vocabulary from real-life context	Applying (K3)
CO2	listen/view and comprehend different spoken discourses / excerpts in different accents	Applying (K3)
CO3	read different genres of texts adopting various reading strategies	Analyzing (K4)
CO4	write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic	Creating (K6)
CO5	speak clearly, confidently, comprehensibly and communicate with others using appropriate communicative strategies	Creating (K6)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2	3	2	2		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		1		
CO5									2	3		2		

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		16	30	37		17	100
CAT2		17	30	37		16	100
CAT3		13	33	37		17	100
ESE		7	21	37		35	100

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





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 differential equations.	
Unit - I	Matrices:	9
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.		
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.		
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: $e^{ax} - \cos ax / \sin ax - x^n - e^{ax}x^n$ , $e^{ax}\sin bx$ and $e^{ax}\cos bx - x^n\sin ax$ and $x^n\cos ax$ – 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 & Inverse 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) – Solution of linear ODE of second order with constant coefficients.		

**List of Exercises / Experiments:**

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

**\*Alternate week****Lecture: 45, Tutorial and Practical:15, Total:60****TEXT BOOK:**

1.	Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1 <sup>st</sup> Edition, McGraw Hill Education, New Delhi, 2016.
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**REFERENCES:**

1.	Kreyszig E., "Advanced Engineering Mathematics", 10 <sup>th</sup> Edition, John Wiley Sons, 2011.
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", 2 <sup>nd</sup> Edition, Pearson India Education, New Delhi, 2018.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	solve engineering problems which needs matrix computations.	Applying (K3)
CO2	identify the appropriate method for solving first order ordinary differential equations.	Applying (K3)
CO3	solve higher order linear differential equations with constant and variable coefficients.	Applying (K3)
CO4	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.	Applying (K3)
CO5	apply Laplace Transform to find solutions of Linear Ordinary Differential Equations	Applying (K3)
CO6	know the basics of MATLAB and computing eigen values and eigen vectors of real matrix by MATLAB.	Understanding (K2), Manipulation (S2)
CO7	solve ordinary differential equations with constant and variable coefficients and simultaneous first order ordinary differential equations using MATLAB.	Applying (K3), Manipulation (S2)
CO8	compute Laplace and inverse Laplace Transform of basic functions and solve Second Order ODE by using Laplace Transform with MATLAB.	Applying (K3), Manipulation (S2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1										
CO2	3	3	2	1										
CO3	3	3	2	1										
CO4	3	3	2											
CO5	3	3	2	1										
CO6					3									
CO7					3									
CO8					3									
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20PHT11 - APPLIED PHYSICS**

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	0	0	3

Preamble	This course aims to impart the essential concepts of propagation of elastic waves, acoustics, ultrasonics, laser and fiber optics, quantum physics, crystal structure and crystal defects. It also describes the physical phenomena related to the aforementioned concepts and their applications in engineering and provides motivation towards innovations	
Unit - I	Propagation of Elastic Waves:	9
Oscillatory Motion: Introduction to simple harmonic motion - Damping velocity - Damping coefficient - Differential equation of simple harmonic motion - Velocity and acceleration - Restoring force - Vibration of a spring and mass system - Frequency response - Phase response - Resonance - Wave motion: Definition of a plane progressive wave - Attenuation of waves - Differential equation of a plane progressive wave - Phase velocity - Phase and phase difference - Solution of the differential equation of a plane progressive wave.		
Unit - II	Acoustics and Ultrasonics:	9
Acoustics: Introduction - Reverberation and reverberation time - Growth and decay of sound - Sabine's formula for reverberation time – Determination of sound absorption coefficient – Design of an auditorium: Factors affecting acoustics of buildings and the remedies. Ultrasonics: Introduction – Properties of ultrasonic waves – Generation of ultrasonic waves: Magnetostrictive generator and Piezoelectric generator - Determination of velocity of ultrasonics in a liquid: Acoustic grating – Industrial application: Non-destructive testing - Other applications of ultrasonic waves (qualitative).		
Unit - III	Laser and Fiber Optics:	9
Laser and Applications: Introduction – Interaction of light with matter - Three quantum process: Stimulated absorption, spontaneous emission and stimulated emission - Population inversion - Einstein's coefficients and their relations - Pumping methods - Nd:YAG laser - CO <sub>2</sub> laser - Holography. Fiber Optics and Applications: Introduction - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optics communication system (qualitative) - Fiber optic sensors: Temperature and displacement sensors.		
Unit - IV	Quantum Physics:	9
Introduction - Blackbody radiation - Planck's quantum hypothesis - Compton scattering (qualitative) - de Broglie's hypothesis - Properties of matter waves - Application of Heisenberg uncertainty principle - Schrodinger's time independent and time dependent wave equations - Physical significance of wave function - The free particle - Potential energy step - Infinite potential well (one - dimensional).		
Unit - V	Crystal Physics:	9
Introduction - Classification of solids - Space lattice - Crystal structure - Unit cell - Bravais lattice - Single and polycrystalline materials - Lattice planes - Miller indices - Indices of crystal direction - Interplanar spacing in cubic system - Hexagonal close packed crystal structure and c/a ratio - Symmetry -Symmetry elements in cubic crystal - Crystal imperfections: line, surface and volume imperfections - Features of crystal imperfections (qualitative).		

**Total: 45****TEXT BOOK:**

1.	Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics", 11 <sup>th</sup> Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019.
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**REFERENCES:**

1.	Purnima Khare and Swarup A., "Engineering Physics: Fundamentals and Modern Applications", 1 <sup>st</sup> Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts, 2009.
2.	Gaur R.K. and Gupta S.L., "Engineering Physics", 8 <sup>th</sup> Edition, Dhanpat Rai and Sons, New Delhi, 2009.
3.	Tamilarasan K. and Prabu K., "Engineering Physics – I", 3 <sup>rd</sup> Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	apply the concepts of growth and decay of sound energy in a hall to compute Sabine's formula to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic wave, working of acoustic grating & non-destructive testing using ultrasonic waves.	Applying (K3)
CO3	apply the concepts of stimulated emission to explain the working and the applications of laser in engineering and technology, and to apply the principle of propagation of light through optical fiber to compute acceptance angle and numerical aperture to comprehend the loss in optical fiber, fiber optic communication system and working of fiber optic sensors.	Applying (K3)
CO4	use the concepts of quantum mechanics to describe the behavior of electrons in a metal by solving Schrodinger's wave equation for particle motion in infinite potential well.	Applying (K3)
CO5	utilize the concepts of the seven crystal systems to obtain interplanar spacing in cubic lattice and c/a ratio of HCP crystal structure, and to comprehend symmetry elements, reciprocal lattice and the types of crystal imperfections and their impacts.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	35	45				100
CAT3	25	35	40				100
ESE	20	40	40				100

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



**20CYT11 - APPLIED CHEMISTRY**  
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	0	0	3

Preamble	Applied Chemistry course explores the basic principles and advancements of chemistry in the field of engineering and technology. It aims to impart the fundamentals of chemistry towards innovations in science and technology and also for societal applications.	
Unit - I	Water Technology:	9
Introduction - sources of water - impurities in water - types of water - hardness of water- expression of hardness (simple problems) - units of hardness –estimation of hardness of water by EDTA method – determination of alkalinity - disadvantages of using hard water in Industries - boiler troubles - scale and sludge, boiler corrosion, caustic embrittlement, priming and foaming - softening of water: i) Internal treatment process - carbonate and calgon conditioning ii) External treatment method -demineralization process iii) Treatment of water for municipal water supply (Removal of suspended particles and disinfection methods, Break-point of chlorination).		
Unit - II	Electrochemistry:	9
Introduction – electrochemical cells - applications of electrochemical series - reference electrode - standard calomel electrode - ion selective electrode - glass electrode - concentration cells - electrode and electrolyte concentration cells (simple problems) -applications- potentiometric titrations - acid-base, redox, precipitation titrations - advantages- conductometric titrations - strong acid vs strong base, weak acid vs strong base, mixture of weak and strong acid vs strong base- advantages of conductometric titrations.		
Unit - III	Corrosion and its Control:	9
Introduction – causes and effects of corrosion - types of corrosion - chemical corrosion – Pilling Bed-worth rule - electrochemical corrosion –types - galvanic corrosion, concentration cell corrosion – other types of corrosion -stress, intergranular and microbiological corrosion- galvanic series - factors influencing rate of corrosion – corrosion control methods - design and material selection, anodic protection, corrosion inhibitors, protective coatings - i) metallic coatings : hot dipping (tinning and galvanizing) ii) non-metallic coating : anodizing iii) organic coating : paints – constituents and their functions.		
Unit - IV	Fuels and Combustion:	9
Introduction – classification of fuels - characteristics of a good fuel - combustion - calorific values – gross and net calorific values - Dulong's formula (simple problems) - Flue gas analysis by Orsat's method - ignition temperature - spontaneous ignition temperature - explosive range - solid fuels - coal and its varieties – proximate and ultimate analysis – significance – metallurgical coke - Otto-Hoffman byproduct method - liquid fuel - refining of petroleum – manufacture of synthetic petrol - hydrogenation of coal - Bergius process - knocking - octane number – cetane number - gaseous fuel - water gas.		
Unit - V	Polymers:	9
Introduction – terminology - classification - polymerization - types of polymerization (definition only)- polymerisation techniques- bulk, solution, suspension and emulsion polymerisation - plastics- difference between thermoplastics and thermosetting plastics - compounding of plastics- plastic moulding methods - compression, injection, extrusion and blow moulding methods - industrial polymers: preparation, properties and applications of PVC, PAN, polyurethane, polyesters –biodegradable polymers-classification and applications.		

**Total: 45****TEXT BOOK:**

1. Wiley Editorial Board, "Wiley Engineering Chemistry", 2<sup>nd</sup> Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019.

**REFERENCES:**

1. Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., "Applied Chemistry", 6<sup>th</sup> 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, 2017.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply the suitable water softening methods to avoid boiler troubles.	Applying (K3)
CO2	apply the principle of electrochemistry for various applications.	Applying (K3)
CO3	make use of corrosion control methods to solve corrosion related problems.	Applying (K3)
CO4	illustrate the quality of fuels from its characteristics.	Understanding (K2)
CO5	explain the types of polymers, plastics and fabrication methods.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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	1												
CO5	3	1												
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20ECT11 - BASICS OF ELECTRICAL ENGINEERING**

Programme & Branch	BE – Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	ES	3	0	0	3

Preamble	To gain base knowledge and develop simple models of Electric generating station with safety measure and demonstrate the background details.	
Unit - I	Introduction to Power Engineering and Storage:	9
Electrical power sources - basics: hydroelectric, thermal, nuclear, Wind, Solar; Basics of batteries and their uses. Storage: Batteries, Types and their Uses.		
Unit - II	DC Machines and Measuring Instruments:	9
DC Motors and DC Generators: Construction, Types, EMF equation, Characteristics and Applications. Moving Iron and Moving Coil Instrument, Dynamometer type Wattmeter, Induction Type Energy Meter.		
Unit - III	Transformers:	9
Construction, Principle of Operation, and EMF equation, Transformer on: No Load and Load; Losses and Efficiency and Applications. Transformer Connections: Single phase and Three Phase connections.		
Unit - IV	AC Machines:	9
Induction Motor (3-Phase and 1-Phase) and Synchronous Motor, and Stepper Motor - Construction, Principle of Operation, Characteristics, Types and Applications.		
Unit - V	House Wiring and Safety:	9
Phase, Neutral and Earth. Basic Housing Wiring. Tools and Components, Different types of Wiring, Stair case, Fluorescent lamp, Ceiling Fan, Basic Safety Measures at Home and Industry: Earthing-Pipe and Plate, Grounding terms and Cardio Pulmonary Resuscitation(CPR).		

**Total:45****TEXT BOOK:**

1.	Jegathesan V., Vinoth Kumar K. and Saravanakumar R., "Basic Electrical and Electronics Engineering", Wiley India Private Limited, New Delhi, Reprint 2013.
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**REFERENCES:**

1.	Edward Huges, "Electrical and Electronics Technology", 12 <sup>th</sup> Edition, Pearson/Prentice Hall, Harlow, England, Newyork, 2016.
2.	Mehta V.K., Rohit Mehta, "Principles of Electrical Engineering and Electronics", 3 <sup>rd</sup> Edition, S-Chand Publications, New Delhi, 2014.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	understand the sources of Power Generation and its operations	Understanding (K2)
CO2	paraphrase and distinguish motor and generation action and understand the Basic Measuring Instruments	Applying(K3)
CO3	comprehend the construction and working of transformers and its testing procedure.	Applying(K3)
CO4	discuss the details of construction and operation AC machines	Applying(K3)
CO5	deliberate on wiring circuit construction accessories and safety Procedure and measures.	Applying(K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											1	
CO2	3	2	1	1									2	
CO3	3	2	1	1									2	2
CO4	3	2	1	1									3	2
CO5	3	2	2	1									3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	55	5				100
CAT2	40	50	10				100
CAT3	30	60	10				100
ESE	40	50	10				100

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





<b>Programme &amp; Branch</b>	<b>B.E- Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>1</b>	<b>PC</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

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 Circuit Analysis:	9+3
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 Circuit Analysis:	9+3
Review of AC concepts-Mesh Analysis-Nodal Analysis -Superposition Theorem-Thevenin Theorem, Norton Theorem-Maximum Power Transfer Theorem		
Unit - III	Transient Analysis:	9+3
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 and Coupled Circuits:	9+3
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. Introduction to coupled circuits-Self Inductance and Mutual Inductance.		
Unit - V	Two Port Networks:	9+3
Two-port Network-Open-Circuit Impedance (Z) Parameters-Short-Circuit Admittance (Y) Parameters-Transmission (ABCD) Parameters-Hybrid (H) Parameters-Inter-Relationships of different Parameters and its analysis-Interconnection of Two-port Network-Lattice Network.		

**Lecture:45, Tutorial:15, Total: 60****TEXT BOOK:**

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|----|--|
| 1. | Sudhakar A. and Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis", 5 <sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2015. |
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**REFERENCES:**

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| 1. | Hayt W.H., Kemmerly J.E., Durbin S.M., "Engineering Circuit Analysis", 8 <sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2013. |
| 2. | Ravish R. Singh, "Electrical Networks", 14 <sup>th</sup> Reprint, Tata McGraw-Hill, New Delhi, 2016.                               |



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	analyse circuit transients for RL,RC and RLC circuits.	Analysing (K4)
CO4	apply condition for resonance in series and parallel circuits to find the various parameters.	Applying (K3)
CO5	determine the various parameters in a Two Port network.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									3	
CO2	3	2	1	1									3	
CO3	3	3	2	1									3	
CO4	3	2	1	1									3	
CO5	3	2	1	1									3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70	-			100
CAT2	10	10	70	10			100
CAT3	5	15	80	-			100
ESE	5	10	70	15			100

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

**20ECL11 - BASICS OF ELECTRICAL ENGINEERING LABORATORY**

<b>Programme &amp; Branch</b>	<b>BE – Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>1</b>	<b>ES</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

<b>Preamble</b>	To apply the knowledge gained on basic electrical machines with safety measures.
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**List of Exercises / Experiments:**

1.	Multi-meter Usage and Testing for Basic Circuit Elements.
2.	Simple Electric Circuit Making: Fluorescent lamp and Staircase Wiring.
3.	Safety : Demo: First Aid - CPR
4.	Magnetic Circuit Analogue to Electric Circuit. - Demo. DC and AC Machines Parts Identifications.
5.	Load Test on Series Motor.
6.	Load Test on Single Phase Transformer.
7.	Measurement of Earth Resistance.
8.	Three Phase Transformer Terminal Connections and Calculations (Star and Delta)
9.	Identifying the parts of Table/Ceiling fan, Troubleshooting and Repairing it.
10.	Making a Reduced Model of Electric Power Generation Station or the Machines Associated.

**Total:30****REFERENCES/MANUALS/SOFTWARES:**

1.	Laboratory Manual
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<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	perform the testing procedure on DC motors, transformers with its connection for its operation under loaded condition.	Applying (K3), Precision (S3)
CO2	model a scaled / reduced version of a generating station with learning of safety ground measures and perform first aid general cpr procedure.	Applying (K3), Precision (S3)
CO3	identify machineries parts, construct, test, and evaluate - simple lighting circuits.	Applying (K3), Manipulation (S2)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	2	2	1									2	3
CO2	3	3	3	3	2									
CO3	3	2	2	1									2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														



**20PHL11 – PHYSICAL SCIENCES LABORATORY I**  
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	BS	0	0	2	1

Preamble	This course aims to impart hands on training in the determination of the physical parameters such as Young's modulus, rigidity modulus, frequency of vibration, velocity of ultrasonic waves, compressibility of water, wavelength of laser, acceptance angle and the numerical aperture of an optical fiber, and to develop the skills in handling different basic instruments and also aims to impart the basic concepts of volumetric, conductometric and pH meter experiments and thereby, to improve the analytical capability.
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**List of Exercises / Experiments:**

1.	Determination of the Young's modulus of the material of a given beam using uniform bending method.
2.	Determination of the rigidity modulus of the material of a given wire using torsional pendulum.
3.	Determination of frequency of electrically vibrating rod by forming standing waves using Melde's apparatus.
4.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer.
5.	Determination of (i) the wavelength of a semiconductor laser and (ii) the acceptance angle and the numerical aperture of a given optical fiber.
6.	Estimation of total, temporary and permanent hardness of water by EDTA method.
7.	Estimation of $\text{Ca}^{2+}$ and $\text{Mg}^{2+}$ hardness separately by EDTA method.
8.	Estimation of alkalinity of the given water sample.
9.	Conductometric titration -Mixture of acids.
10.	Estimation of hydrochloric acid using pH meter.

**Total: 30****REFERENCES/MANUALS/SOFTWARES:**

1.	Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 1 <sup>st</sup> Edition, SCM Publishers, Erode, 2020.
2.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1 <sup>st</sup> Edition, Rajaganapathy Publishers, Erode, 2020.

**COURSE OUTCOMES:**

On completion of the course, the students will be able to

**BT Mapped  
(Highest Level)**

CO1	determine the Young's modulus of a material using the concepts of elasticity and bending moment of a beam and to determine the rigidity modulus of a wire using the concepts of twisting couple and to compute the frequency of electrically vibrating rod using the concept of standing waves formed in fixed vibrating string.	Applying (K3), Precision (S3)
CO2	determine the wavelength of a semiconductor laser beam using the concept of diffraction of light, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concepts of total internal reflection and divergence of light in air and estimate the amount of hardness for the given water sample by EDTA method, and the amount of alkalinity for the given water sample.	Applying (K3), Precision (S3)
CO3	demonstrate the conductivity meter and pH meter to estimate the amount of the given solution.	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										
CO2				3										
CO3				3										

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



Kongu Engineering College, Perundurai, Erode – 638060, India

**20EGT21 - ADVANCED COMMUNICATION SKILLS**  
(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	20EGT11 – English Language Skills	2	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at B1Level in the Common European Framework (CEFR).						
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Unit - I	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase –VI</b>	<b>9</b>
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**Listening** – Job and career related descriptions and conversations – requests of different kinds and the responses – **Speaking** - Career choices and professional skills – making requests and responding to requests – **Reading** – Using texts about jobs and careers – about different societies and cultural differences – **Writing** – Resumes, CVs and job oriented advertisements – business and career related emails – **Grammar & Vocabulary** – Gerunds and elements of comparison – requests and indirect requests.

Unit - II	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – VII</b>	<b>9</b>
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**Listening** – Expository and narrative descriptions – information about different cultures, nations and societies. **Speaking** – Narrating and describing – talking about other countries and other cultures – **Reading** – Using texts about media and information technology – living abroad and experiencing different cultures – **Writing** – Blog writing – brochures and tourist pamphlets – **Grammar & Vocabulary** – The past tense forms - noun phrases and relative clauses.

Unit - III	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – VIII</b>	<b>9</b>
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**Listening** – Consumerism – product description – complaints and redressal – environmental issues – ecology – saving the planet – **Speaking** – Talking about problems, issues, complaints – solutions and redressal – talking about environmental issues – **Reading** – Using texts on segregating wastes – recycling and reusing – texts on environmental issues – **Writing** – Online reviews, articles and writing web content – **Grammar & Vocabulary** – Phrases and sentences used for describing problems – passives – prepositions and infinitives.

Unit - IV	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – IX</b>	<b>9</b>
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**Listening** – Education, learning and the choice of courses – various services needed in daily life – self-improvement for success in life – **Speaking** - Discussions about educational and career oriented issues – talking about everyday services – giving advice and self improvement – **Reading** – Reading about learning strategies and learning styles – using texts about personality development – **Writing** – Writing about hobbies – pastime and individual skills – writing short articles on everyday life and personality development – **Grammar & Vocabulary** – Using of “would” and certain gerund forms – use of modals, verbs, gerunds, negative questions and infinitives.

Unit - V	<b>Listening, Speaking, Reading, Writing and Grammar &amp; Vocabulary. Activity Based Learning – Phase – X</b>	<b>9</b>
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**Listening** – Historical narratives – biographies and learning about the future – important life events, milestones and happenings of the past – **Speaking** – Talking about the past, present and the future – talking about important events in life – **Reading** – Texts about new technologies and future science – using texts about social organization, culture and social practices – **Writing** – Biographical sketches – historical events – famous personalities, stages of life and getting along with people – **Grammar & Vocabulary** – Future tense forms – time clauses and certain “if clauses”.

**Total: 45**

**TEXT BOOK:**

1.	Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student’s Book 3”, 4 <sup>th</sup> Edition, Cambridge University Press, New York, 2017.
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**REFERENCES:**

1.	Sanjay Kumar and Pushp Lata, “Communication Skills: A Workbook based on AICTE Syllabus”, Oxford University Press, 2018.
2.	Board of Editors, “Skills Annexe: Functional English for Success”, Orient BlackSwan, Hyderabad, 2013.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	use functional grammar for improving communication skills	Applying (K3)
CO2	listen and comprehend different spoken excerpts critically and infer Unspoken and implied meanings.	Applying (K3)
CO3	read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation.	Analyzing (K4)
CO4	write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.	Creating (K6)
CO5	speak effectively, to express opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies.	Creating (K6)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			1	3	1	1		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		2		
CO5									2	3		2		

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		13	30	33	-	17	100
CAT2		13	33	37	-	17	100
CAT3		20	30	33	-	17	100
ESE		6	40	36	-	18	100

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



Programme & Branch	All BE/BTech 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 – 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 – 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 – 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 Exercises / Experiments:**

1.	Finding ordinary and partial derivatives
2.	Computing extremes of a single variable function
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

**\*Alternate week****Lecture: 45, Tutorial and Practical:15, Total:60****TEXT BOOK:**

1.	Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1 <sup>st</sup> Edition, McGraw Hill Education, New Delhi, 2016.
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**REFERENCES/MANUALS/SOFTWARES:**

1.	Kreyszig E., "Advanced Engineering Mathematics", 10 <sup>th</sup> Edition, John Wiley Sons, 2011.
2.	Dass H K, "Higher Engineering Mathematics", 3 <sup>rd</sup> Revised Edition, S.Chand and Co., New Delhi, 2014.
3.	MATLAB Manual.

**COURSE OUTCOMES:****BT Mapped**



On completion of the course, the students will be able to		(Highest Level)
CO1	compute extremal values which arise in function of several variables.	Applying (K3)
CO2	solve Problems involving Double and Triple integrals.	Understanding (K2)
CO3	apply the concept of vectors in engineering problems.	Applying (K3)
CO4	identify, construct and apply analytic functions in electrostatics and fluid flow problems.	Applying (K3)
CO5	evaluate complex integrals which are extensively applied in engineering.	Applying (K3)
CO6	compute maxima and minima of a single variable function, gradient, curl and divergence of a vector function using MATLAB.	Understanding (K2), Manipulation (S2)
CO7	evaluate Double, Triple integrals and determine area between two curves using MATLAB	Applying (K3), Manipulation (S2)
CO8	construct analytic function, find bilinear transformation and compute poles and residues using MATLAB.	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												
CO2	3	3	2											
CO3	3	3												
CO4	3	3												
CO5	3	3	2											
CO6					3									
CO7					3									
CO8					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)





Programme & Branch	BE - Electronics and Communication Engineering, BE-Computer Science and Engineering, BTech- Information Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	BS	3	0	0	3

Preamble	This course aims to impart the knowledge on the physics of conductors, superconductors, semiconductors, magnetic materials, dielectrics, optoelectronic materials and nano materials. It also describes the working of the select solid state and optoelectronic devices and the applications of aforementioned materials in Communication Engineering and Computer Science and Engineering and Information Technology and provides motivation towards innovations.						
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<b>Unit - I</b>	<b>Conducting and Superconducting Materials:</b>	<b>9</b>
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Conducting Materials: Introduction - Classical free electron theory of metals - Electrical conductivity - Drawbacks of classical free electron theory - Quantum free electron theory - Quantum statistics: Fermi distribution function and Effect of temperature on Fermi function - Superconducting Materials: Introduction - Properties of superconductors - Type I and Type II superconductors - Applications: Cryotron - Superconducting quantum interference device (SQUID).

<b>Unit - II</b>	<b>Semiconducting Materials and Devices:</b>	<b>9</b>
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Introduction - Intrinsic semiconductor: Carrier concentration, Fermi level in intrinsic semiconductor, Variation of intrinsic conductivity with temperature and Determination of band gap - Extrinsic semiconductor: Carrier concentration in N-type and P-type semiconductors, Fermi level in Extrinsic semiconductors, Variation of Fermi level with temperature and impurity concentration - Hall effect: Determination of Hall coefficient and its applications - Uni-junction Transistor: Construction and characteristics – Junction field Effect Transistor: Construction and characteristics.

<b>Unit - III</b>	<b>Magnetic and Dielectric Materials:</b>	<b>9</b>
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Magnetic materials: Introduction - Classification of magnetic materials based on magnetic moment - Ferromagnetism: Domain theory of ferromagnetism, Hysteresis loss, Soft and hard magnetic materials and Application: Transformer core. Dielectrics Materials: Introduction - Dielectric constant - Types of polarization (qualitative) - Temperature dependence of polarization - Frequency dependence of total polarization - Dielectric loss (qualitative) - Dielectric breakdown – Ferroelectricity and its applications.

<b>Unit - IV</b>	<b>Optoelectronic Materials and Devices:</b>	<b>9</b>
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Introduction - Photodetectors: p-i-n photo diode - Avalanche photo diode – Effect of Anisotropic crystals in light propagation: Index ellipsoid of uniaxial and biaxial crystals -Electro-Optic effect: Pockel's effect and Kerr effect - Light modulators - Types of light modulators - Electro refractive modulators: Electro-optic amplitude and Phase modulators - Electro absorptive modulators: Franz - Keldysh and Stark effect modulators.

<b>Unit - V</b>	<b>Nano Materials:</b>	<b>9</b>
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Introduction - Properties of nano-materials - Low dimensional structures: Quantum dot, quantum wire and quantum well - Production techniques: Ball Milling, lithographic method, physical vapor deposition method, chemical vapor deposition method and sol gel method - Applications of nano-materials – Carbon nanotubes: Structures, properties, synthesis by laser ablation method - Applications of carbon nanotubes.

**Total:45****TEXT BOOK:**

1. Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics", 11<sup>th</sup> Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019 for Unit I, II, III and Unit V.
2. Palanisamy P.K., "Semiconductor Physics and Opto electronics", 2<sup>nd</sup> Edition, Sci Tech Publications, Chennai, 2010, for Unit IV.

**REFERENCES:**

1. Kachhava C.M., "Solid State Physics, Solid State Device and Electronics", 1<sup>st</sup> Edition, New Age International, New Delhi, 2003.
2. Charles Kittel, "Introduction to Solid State Physics", 8<sup>th</sup> Edition, John Wiley & Sons, New Jersey, 2004.
3. Tamilarasan K. and Prabu K., "Materials Science", 1<sup>st</sup> Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

**COURSE OUTCOMES:**

On completion of the course, the students will be able to

CO1	apply the concepts of classical and quantum free electron theory of metals to compute	BT Mapped (Highest Level) Applying (K3)
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	the electrical conductivity of metals and to comprehend the effect of temperature on Fermi function and to summarize the types, properties and applications of superconductors (Cryotron and Superconducting quantum interference device).	
CO2	use the concept of density of states to compute the carrier concentration, electrical conductivity and band gap of intrinsic semiconductors and to compute the carrier concentration of extrinsic semiconductors, and also to explain the phenomenon related to Hall Effect and the working of UJT and JFET.	Applying (K3)
CO3	apply the domain theory of ferromagnetism to explain hysteresis and to apply the concept of electric dipole moment and electric polarization to comprehend the select polarization mechanisms in dielectrics and to describe the related phenomenon.	Applying (K3)
CO4	apply the theory of photoconductivity and p-n junction to describe the materials, construction, working and applications of the select optoelectronic devices and to apply the concept of index ellipsoid of uniaxial and biaxial crystals to explain the principle, working and application of opto-electric modulators.	Applying (K3)
CO5	utilize appropriate methods to prepare nano-materials and carbon nano-tubes, and to comprehend their properties, types 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	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	20	40	40				100
CAT2	20	40	40				100
CAT3	25	35	40				100
ESE	20	40	40				100

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

**20CYT23 - CHEMISTRY OF ELECTRONIC MATERIALS**

Programme & Branch	B.E – ECE, CSE, EEE, EIE & B.TECH- IT branches	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Chemistry	2	BS	3	0	0	3

Preamble	Chemistry of electronic materials aims to equip the engineering students to realize the importance of chemistry in polymeric materials, metal finishing, organic electronic materials, fuel cells, renewable energy and e-waste management.	
Unit - I	Chemistry of Polymeric and Composite Materials :	9
Introduction - structure and property relationship of polymers - plastics - properties and uses of plastics as engineering materials - rubbers (elastomers) - natural rubber- processing of latex- vulcanization of rubber - synthetic rubbers- preparation, properties and uses of thiokol and butyl rubber- polymer blends and alloys - fibres-physical properties-types-spinning processes- composites - classification of composites - fibre reinforced plastics- processing , properties and uses of fiber reinforced plastics		
Unit - II	Industrial Metal Finishing :	9
Introduction – technological importance of metal finishing- methods of metal finishing - manufacturing of electronic component-PCB fabrication- essential of metal finishing: polarization, decomposition potential and overpotential - surface preparation - Electroplating – Process - effect of plating variables on the nature of electrodeposit - electroplating of chromium and silver. Electroless plating - electroless copper plating on printed circuit board - electroless nickel plating process -Distinction between electroplating and electroless plating- advantages of electroless plating.		
Unit - III	Chemistry of Organic Electronic Materials and Fuel Cells:	9
Introduction-Organic semiconducting materials – principle and applications - advantages over inorganic semiconducting materials - P-type and N-type organic semiconducting materials (definition and examples) - conducting polymers and its applications - organic dielectrics (principle and example) - organic light emitting diodes - working and applications. Fuel Cells: Importance and classification of fuel cells - description, principle, components, applications and environmental aspects of fuel cells: alkaline fuel cells, phosphoric acid, molten carbonate and direct methanol fuel cells.		
Unit - IV	Renewable Energy Resources:	9
Introduction – global energy consumption scenario- types of energy resources - nuclear energy - nuclear power reactor - breeder reactors - applications and disadvantages of nuclear energy - design, working, advantages and disadvantages of solar energy, hydropower, wind energy, geothermal energy, tidal and wave power, ocean thermal energy - biomass and biofuels - hydrogen as an alternate fuel - hydrogen production - advantages ,disadvantages and applications - nanotechnology for energy sector.		
Unit - V	E-Waste and its Management:	9
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 – global Scenario of E-waste – E-waste in India- case studies.		

**Total: 45****TEXT BOOK:**

1.	Wiley editorial board. "Wiley Engineering Chemistry". 2 <sup>nd</sup> Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019, for Units I,II,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 Units I, III, IV, V.

**REFERENCES:**

1.	Palanna O., "Engineering Chemistry" , McGraw Hill Education, New Delhi, 2017 for Units II,III.
2.	B.Joshi & Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	utilize the polymeric and composite materials for various applications	Applying (K3)
CO2	employ the concept of coating techniques in industrial metal finishing	Applying (K3)
CO3	apply the concepts of fuel cells, organic electronic materials and its applications	Applying (K3)
CO4	explain the role of renewable energy resources to attain sustainability	Understanding (K2)
CO5	utilize the knowledge to handle the e-waste and reduce its impacts on environment	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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												
CO4	3	2	1	1			3							
CO5	3	2	1	1			2							
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECT21 - ELECTROMAGNETIC FIELDS**

Programme & Branch	BE – Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	PC	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.		
Unit - II	Conductors and Dielectrics:	9+3
Electric current – Current density – point form of ohm's law – continuity equation for current. Electric Polarization- 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 – Power flow in a co-axial cable.		
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.		

**Lecture: 45, Tutorial:15, Total:60**

**TEXT BOOK:**

1.	William H. Hayt, Jr and John A. Buck, "Engineering Electromagnetics", 7 <sup>th</sup> Edition, Tata McGraw Hill Publishing Company, NewDelhi, 2011.
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**REFERENCES:**

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



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply the basic laws to determine electric field intensity and potential for point, line and surface charge distributions.	Applying(K3)
CO2	apply boundary conditions and Laplace equations to derive the capacitance of parallel Plate capacitors	Applying(K3)
CO3	calculate Magnetic Field intensity for various current carrying conductors.	Applying(K3)
CO4	make use of the basic laws to develop Maxwell's Equation and Wave Equation.	Applying(K3)
CO5	compute the characteristics of uniform plane waves in conductor, lossless and lossy dielectric media	Applying(K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									1	
CO2	3	2	1	1									2	
CO3	3	2	1	1									2	
CO4	3	2	1	1									2	
CO5	3	2	1	1									2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	15	35	50				100
ESE	20	30	50				100

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

**20MEC11 - ENGINEERING DRAWING**

(Common to Civil, Mechanical, Mechatronics, Automobile Engineering, Chemical &amp; Food Technology Branches)

Programme & Branch	BE(Civil, Mech, MTS, Auto) & BTech(Chem, FT)	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	2	0	2	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:	9
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:	9
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:	9
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:	9
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:	9
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, Practical:30, Total:60****TEXT BOOK:**

1.	Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15 <sup>th</sup> Edition, New Age International Pvt. Ltd., New Delhi, 2018.
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**REFERENCES:**

1.	Basant Agrawal, Agrawal C.M., "Engineering Drawing", 2 <sup>nd</sup> Edition, McGraw Hill Education, 2019.
2.	Gopalakrishnana K.R. "Engineering Drawing", Volume. I & II, Subhas Publications, Bengaluru, 2014.
3.	Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes.	Understanding (K2)
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 in to orthographic projection.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2								3	2	2	2	3
CO2	3	2	1	1						3	2	3	2	3
CO3	3	2	1	1						3	2	3	2	3
CO4	3	2	1	1						3	2	3	2	3
CO5	3	2	1	1						3	2	3	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	25	35	40				100

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

### 20MEL11 – ENGINEERING PRACTICES LABORATORY

(Common to Civil, Mechanical, Mechatronics, Automobile Engineering, Chemical & Food Technology Branches)





<b>Programme &amp; Branch</b>	<b>BE (Civil, Mech, MTS, Auto) &amp; BTech (Chem, FT)</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>1</b>	<b>ES</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

<b>Preamble</b>	This course is designed to provide a hands-on experience in basic of mechanical and electrical engineering practices.
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**List of Exercises / Experiments:**

<b>PART A – MECHANICAL ENGINEERING</b>	
1.	To prepare square or rectangular shaped MS plates using power tools for cutting, polishing and shaping to the required dimensions.
2.	To carryout drilling, tapping and assembly on the given MS plates.
3.	To carryout thread forming on a GI/PVC pipes and prepare water leak proof water line from overhead tank.
4.	To prepare a wood or plywood box/tray/any innovative models using modern power tools like cutting machine, router, jigsaw, power screw driver etc.
5.	Welding practice through arc welding / simulator
<b>PART B – ELECTRICAL AND ELECTRONICS ENGINEERING</b>	
1.	Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection
2.	Wiring circuit for fluorescent lamp and Stair case wiring
3.	Measurement of Earth resistance
4.	Soldering of Simple Circuits and trouble shooting
5.	Implementation of half wave and full wave Rectifier using diodes

**Total: 30****REFERENCES / MANUAL / SOFTWARE:**

1.	Engineering Practices Laboratory Manual.
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<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	plan the sequence of operations for effective completion of the planned models/ innovative articles	Creating (K6), Precision (S3)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3), Precision (S3)
CO3	select fuses and Circuit breakers	Understanding (K2), Manipulation (S2)
CO4	perform house wiring and realize the importance of earthing	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	2		3	3	2	1			3	3		3		
CO2	2		3	3	2				3	3		3		
CO3	3		3	3	1				2	2		3		
CO4	3		3	3	1				2	3		3		
CO5	3		3	3	1				2	2		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

**20PHL24 - PHYSICAL SCIENCES LABORATORY II**

<b>Programme &amp; Branch</b>	<b>BE - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Pre requisite</b>	<b>Nil</b>	<b>2</b>	<b>BS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

<b>Preamble</b>	This course aims to impart hands on training in the determination of physical parameters such as specific resistance, band gap, hysteresis loss and thickness of a nano-structured material and also the working UJT, and to develop the skills in handling different basic instruments. This course also aims to impart the significance of $\text{Cl}^-$ , $\text{Cr}^{6+}$ , $\text{DO}$ , $\text{Fe}^{2+}$ and $\text{Cu}^{2+}$ and thereby, to improve the analytical capability. This course also aims to impart the significance of $\text{Cl}^-$ , $\text{Cr}^{6+}$ , $\text{DO}$ , $\text{Fe}^{2+}$ and $\text{Cu}^{2+}$ and thereby, to improve the analytical capability.
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**List of Exercises / Experiments:**

1.	Determination of the specific resistance of the material of a wire using Carey-Foster's bridge.
2.	Determination of the band gap of a semiconductor using post office box.
3.	Observation of the I-V characteristics of a uni junction transistor.
4.	Determination of hysteresis loss in a ferromagnetic material.
5.	Determination of the thickness of a nano-structured material using air-wedge arrangement.
6.	Estimation of chloride ion in the given water sample using Argentometric method.
7.	Estimation of chromium ( $\text{Cr}^{6+}$ ) in wastewater sample.
8.	Determination of dissolved oxygen in the given wastewater sample.
9.	Estimation of iron using permanganometry.
10.	Estimation of copper in the given solution by Iodometric method.

**Total: 30****REFERENCES/MANUALS/SOFTWARES:**

1.	Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 1 <sup>st</sup> Edition, SCM Publishers, Erode, 2020.
2.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1 <sup>st</sup> Edition, Kalaikathir Publishers, Coimbatore, 2020.

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	determine the specific resistance of conducting materials and the band gap of semiconducting materials using the concept of electrical conductivity and to obtain the V-I characteristics of a UJT using the concept of creation of a region with negative resistance.	Applying (K3), Precision (S3)
CO2	determine the hysteresis loss in ferromagnetic materials using the concept of domain theory of ferromagnetism and to determine the thickness of nano-crystalline thin films using the concept of interference of light. Estimation of Chloride and Chromium ( $\text{Cr}^{6+}$ ) in the given water sample and also to determine the dissolved oxygen in the given wastewater sample.	Applying (K3), Precision (S3)
CO3	estimation of iron and copper in the given solution.	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											
CO2			3											
CO3			3											

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

**20VEC11 – YOGA AND VALUES FOR HOLISTIC DEVELOPMENT**



Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	1	0	1	1

Preamble	Providing Value Education to improve the Students' character - understanding yogic life and physical health - maintaining youthfulness - Measure and method in five aspects of life
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Unit - I	Physical Health:	2
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**Manavalakalai (SKY) Yoga:** Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment. **Simplified Physical Exercises:** Need and Objectives of Simplified Physical Exercise - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acupressure, Relaxation exercises - Benefits. **Yogasanas:** Pranamasana - Hastha Uttanasana - Pada Hasthasana - Aswa Sanjalana Asana - Thuvipatha aswa Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana. **Pranayama:** Naddi suddi - Clearance Practice - Benefits.

Unit - II	Life Force:	2
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**Reasons for Diseases:** Body Function - Reason for Diseases and Prevention - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds). **Philosophy of Kaya kalpa:** Enriching Bio-Magnetism - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind. **Maintaining youthfulness:** Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life - Controlling undue Passion. **Kayakalpa practice:** Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

Unit - III	Mental Health:	2
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**Mental Frequencies:** Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. **Shanti meditation:** Shanthi Meditation explanation – benefits. **Thuriya Meditation:** Thuriya Meditation explanation – benefits. **Benefits of Blessing:** Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection.

Unit - IV	Values:	2
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**Human Values:** Self control - Self confidence - Honesty Contentment - Humility – Modesty - Tolerance - Adjustment - Sacrifice – Forgiveness - Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity. **Social Values:** Non violence – Service. Patriotism – Equality. Respect for parents and elders - care and protection - Respect for teacher. Punctuality - Time Management.

Unit - V	Morality (Virtues):	2
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**Importance of Introspection:** I - Mine (Ego, Possessiveness). Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance. Maneuvering of Six Temperaments: Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness). Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability - Creativity ( Improved Memory Power).

Lecture:10, Practical:10, Total:20

**TEXT BOOK:**

1.	Thathuvagnani Vethathiri Maharishi, "Yoga for Youth Empowerment", Vethathiri Publications, 2019.
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**REFERENCES:**

1.	Thathuvagnani Vethathiri Maharishi, "Yoga for Modern Age", Vethathiri Publications, 2019.
2.	Thathuvagnani Vethathiri Maharishi, "Simplified Physical Exercises", Vethathiri Publications, 2019.
3.	Neelam Sharma, "Holistic Education and Yoga", Shipra Publications, 2017.
4.	Dr. Joseph Murphy, "The Power of Your Subconscious Mind", Pushpak Publication, 2019.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	understand the importance of physical health and practice simplified physical yoga exercise.	Applying (K3)
CO2	understand the importance of Kayakalpa exercise to enrich Bio-Magnetism and practice it.	Applying (K3)
CO3	understand the significance of meditation and do meditation to get sound mind.	Applying (K3)
CO4	understand the human and social values to provide service to society.	Applying (K3)
CO5	understand the evil temperaments and five essential qualities acquired through meditation	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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		
CO3						3		3				1		
CO4						3		2	1			1		
CO5						3		3				1		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

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

**20MAT33 - LINEAR ALGEBRA AND TRANSFORMS**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>3</b>	<b>BS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

Preamble	To provide the skills for handling discrete and continuous time signals by applying Fourier transform and Z-Transform and impart knowledge in vector and inner product spaces.	
Unit - I	Vector spaces:	9+3
Definition – Subspaces – Linear combinations and Span – Linear independence – Bases and dimension – Row space, Column space and Null Space.		
Unit - II	Inner Product Spaces:	9+3
Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition.		
Unit - III	Fourier Series:	9+3
Dirichlet's conditions – General Fourier series – Change of interval – Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.		
Unit - IV	Fourier Transform:	9+3
Fourier Integral theorem (without proof) – Fourier transform pair – Properties (without proof) – Transforms of simple functions – Fourier Sine and Cosine transforms – Properties (without proof) – Convolution theorem and Parseval's identity (Statement and applications only).		
Unit - V	Z –Transform:	9+3
Definition – Z-transform of some basic functions – Elementary properties – Inverse Z-transform: Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms: Solution of difference equations.		

**Lecture: 45, Tutorial: 15, Total: 60****TEXT BOOK:**

1.	Howard Anton, Chris Rorres, "Elementary Linear Algebra", 11 <sup>th</sup> Edition, John Wiley & Sons, 2014 for Units I, II.
2.	Ravish R Singh, Mukul Bhatt "Engineering Mathematics", 1 <sup>st</sup> Edition, McGraw Hill Education, New Delhi, 2016 for Units III, IV, V.

**REFERENCES:**

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and Its Applications", 5 <sup>th</sup> Edition, Pearson Education Limited, England, 2016.
2.	Veerarajan T., "Transforms and Partial Differential Equations", 3 <sup>rd</sup> Reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
3.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10 <sup>th</sup> Edition, John Wiley & Sons Limited, 2019.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understand the concept of vector spaces	Understanding (K2)
CO2	apply the concept of inner product spaces in orthogonalization	Applying (K3)
CO3	express given function or data in terms of Fourier series	Applying (K3)
CO4	use the mathematical principles of Fourier transforms which will provide the ability to formulate and solve some of the physical problems of engineering.	Understanding (K2)
CO5	possess knowledge of Z transform to analyze linear time invariant 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												
CO2	3	2												
CO3	3	3	1											
CO4	3	3	2										1	
CO5	3	2	2										1	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	10	50	40	-	-	-	100
CAT2	10	20	70	-	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	10	40	50	-	-	-	100

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



**20CSC31 - PROGRAMMING IN C**  
(Common to all BE/BTech Engineering & Technology branches except CSE, IT )

Programme & Branch	All BE/BTech Engineering & Technology branches except CSE, IT	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2/3	ES	3	0	2	4

<b>Preamble</b>	The course is designed for use by freshmen students taking their first course in programming. It deals with the techniques needed to practice computational thinking, the art of using computers to solve problems and the ways the computers can be used to solve problems. This course also focuses on developing programming skills using C language.	
<b>Unit - I</b>	<b>Introduction to Computer and Problem Solving:</b>	<b>9</b>
Overview of computers : Types, Generations, Characteristics, Basic computer Organization – Problem solving techniques: Algorithms - Flowcharts – Pseudo codes – Structuring the logic: Sequential, selection and repetitive structure		
<b>Unit - II</b>	<b>Introduction to C and Control Statements:</b>	<b>9</b>
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 - decision making and looping statements		
<b>Unit - III</b>	<b>Arrays and Functions:</b>	<b>9</b>
Declaring, initializing and accessing arrays – operations on arrays – Two dimensional arrays and their operations. 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		
<b>Unit - IV</b>	<b>Strings and Pointers:</b>	<b>9</b>
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, passing arguments to function using pointers -pointers and 1D arrays –arrays vs pointers , pointers and strings,		
<b>Unit - V</b>	<b>User-defined Data Types and File Handling:</b>	<b>9</b>
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 Exercises:**

1.	Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential, Selection and repetition structures
2.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators
3.	Programs using decision making and repetitive statements
4.	Programs for demonstrating one-dimensional and two-dimensional numeric array
5.	Programs to demonstrate modular programming concepts using functions and strings (Using built-in and user-defined functions)
6.	Programs to illustrate the use of structures and pointers
7.	Programs to implement file operations

**Lecture:45, Practical : 30, Total:75****TEXT BOOK:**

1.	Reema Thareja, "Programming in C ", 2 <sup>nd</sup> Edition, Oxford University Press, New Delhi, 2018.
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**REFERENCES:**

1.	Yashavant Kanetkar, "Let us C", 16 <sup>th</sup> Edition, BPB Publications, 2018.
2.	Sumitabha Das, "Computer Fundamentals and C Programming", 1 <sup>st</sup> Edition, McGraw Hill, 2018.
3.	Balagurusamy E., "Programming in ANSI C", 7 <sup>th</sup> Edition, McGraw Hill Education, 2017.





<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1:	outline the basics of computers and apply problem solving techniques to express the solution for the given problem	Applying (K3)
CO2:	identify the appropriate looping and control statements in C and develop applications using these statements	Applying (K3)
CO3:	develop simple C programs using the concepts of arrays and modular programming	Applying (K3)
CO4:	apply the concepts of pointers and develop C programs using strings and pointers	Applying (K3)
CO5:	make use of user defined data types and file concept to solve given problems	Applying (K3)
CO6:	demonstrate the execution of flowcharts for the given problem using Raptor	Applying (K3), Precision (S3)
CO7:	demonstrate the application of sequential, selective and repetitive control structures	Applying (K3), Precision (S3)
CO8:	develop solutions to the given problem using derived /user defined data types and functions and also using file concepts	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs /POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	2	1						1	1		1		
CO2	3	2	2						1	1		1		
CO3	3	2	2						1	1		1		
CO4	3	2	2						1	1		1		
CO5	3	2	2						1	1		1		
CO6	3	2	2	2	1				1	1		1		
CO7	3	2	2	2	1				1	1		1		
CO8	3	2	2	2	1				1	1		1		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

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



20CSC34 – DATA STRUCTURES USING C							
Common to ECE, EEE, E & I, MTS Branches							
Programme & Branch	Common to ECE, EEE, E & I , MTS Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Programming in C	3	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.

<b>COURSE OUTCOMES: On completion of the course, the students will be able to</b>		<b>BT Mapped (Highest Level)</b>
CO1	apply List ADT for solving the given problems	Applying (K3) Precision (S3)
CO2	make use of arrays and linked lists to create Stack and Queue ADTs.	Applying (K3) Precision (S3)
CO3	utilize Tree ADT to develop simple application	Applying (K3) Precision (S3)
CO4	make use of Graph ADT for standard problems	Applying (K3) Precision (S3)
CO5	illustrate the use of standard sorting and Hashing Techniques	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	40	50				100
CAT2	5	35	60				100
ESE	5	35	60				100

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



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECT31 - 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 digital logic number systems, code conversion, Boolean algebra, Boolean function minimization using different minimization techniques, and also to design different combinational and sequential logic circuits.	
Unit - I	Binary Numbers and Minimization Techniques:	9
Complements-Signed binary numbers- Binary arithmetic-Binary codes: Weighted and non-weighted codes: BCD, 2421, Gray code, ASCII. 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)		
Unit - II	Gate Level Minimization and Hardware Description Language:	9
Karnaugh map minimization -Implementations of logic functions using universal gates -Comparison of TTL and CMOS characteristics. <b>Verilog:</b> Verilog Basics - Overview of Verilog HDL-Modules and ports-Gate level modeling-Design procedure – Half adder and subtractor – Full adder and subtractor		
Unit - III	Combinational Circuits and Hardware Description Language :	9
Parallel binary adder and subtractor – Carry look ahead adder -BCD adder- Multiplexer- Demultiplexer – Decoder - Encoder – Parity checker and generator – Code converters- Magnitude comparator-design of combinational circuits using Verilog HDL.		
Unit - IV	Sequential Circuits:	9
Introduction, Flipflops: SR, JK, D and T –Level and Edge triggering - Realization of one flipflop using other flipflops-Design and analysis of synchronous sequential circuits: Characteristic, excitation tables and equations, State diagram, State table, State minimization and State assignment -Design of synchronous counters- Ripple counter – Registers: Shift registers, Universal shift register.		
Unit - V	Asynchronous Sequential Circuits:	9
Analysis of asynchronous sequential circuits – Primitive state table – Minimization of primitive state table –State assignment – Excitation table - 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.
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**REFERENCES:**

1.	Charles H. Roth, "Fundamentals of Logic Design", 6th Edition, Thomson Learning, New Delhi, 2013.
2.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, New Delhi, 2017.
3.	Salivahanan S. &Arivazhagan S., "Digital Circuits and Design", 5th Edition, Oxford University Press, New Delhi, 2018.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply boolean laws for logic minimization	Applying (K3)
CO2	apply Karnaugh map techniques for gate level logic minimization	Applying (K3)
CO3	design combinational circuits	Applying (K3)
CO4	design synchronous and asynchronous sequential circuits	Applying (K3)
CO5	realize boolean functions using PLDs	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2		2						1	2	2
CO2	3	2	2	2	2	2			2	2		1	3	2
CO3	3	2	2	2	2	2		1	2	2		2	3	2
CO4	3	2	2	2		2		1				2	3	2
CO5	3	2	2	2		2		1				2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	40	55				100
ESE	5	40	55				100

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

**20ECT32 - SOLID STATE DEVICES AND CIRCUITS**

Programme & Branch	B.E. - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Physics for Communication and Computer Science Engineering	3	PC	3	0	0	3

Preamble	To understand about the construction of power supply circuits, biasing of BJT, mid band analysis of BJT, low and high analysis of BJT amplifiers	
Unit - I	<b>P-N Junction Diode and Special Diodes:</b>	<b>9</b>
Construction of PN junction diodes–VI characteristics–Quantitative theory of PN diode – Transition and diffusion capacitances – Applications: Clipping and clamping circuits - Voltage multipliers - Zener diode – Characteristics of Zener diode- LED-Photo diode - Solar cell		
Unit - II	<b>BJT and its biasing:</b>	<b>9</b>
Construction and Principle of Operation - I/O characteristics:CE, CB and CC configurations-Need for biasing- Load line and Quiescent point- Variation of Quiescent point -Stability factors- Different types of biasing circuits- Method of stabilizing the Q point (Derivation for S only) - Bias compensation techniques.		
Unit - III	<b>Midband Analysis of BJT:</b>	<b>9</b>
CE, CB and CC amplifiers-Midband analysis of CE,CB,CC (BJT) single stage amplifiers using small signal equivalent circuit - Miller's theorem- Analysis using Miller's Theorem - Methods of increasing input impedance using Darlington connection and Bootstrapping(Concept alone) - Multistage Amplifiers (CE-CB).		
Unit - IV	<b>Frequency Response of Amplifiers:</b>	<b>9</b>
Low Frequency Analysis of BJT -Hybrid – $\pi$ Equivalent Circuit of BJTs: Elements in the Hybrid $\pi$ Model- CE Short Circuit Current Gain- Frequency response of multistage amplifiers: Calculation of overall upper and lower cutoff frequencies.		
Unit - V	<b>Thyristors and Power Supply Circuits:</b>	<b>9</b>
SCR, TRIAC- Construction, working and characteristics- Half wave and Full wave Bridge rectifiers with resistive load- Analysis for $V_{dc}$ and ripple voltage with C and L filters. Zener diode regulator -Transistor voltage regulators: Series and shunt- Line regulation and load regulation- Switched Mode Power Supply – General Block diagram.		

**Total:45****TEXT BOOK:**

1.	Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, "Microelectronic Circuits", 7 <sup>th</sup> Edition, Oxford University Press, New York, 2017.
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**REFERENCES:**

1.	Salivahanan S. and Sureshkumar N., "Electronic Devices and Circuits", 4th Edition, McGraw-Hill, New Delhi, 2017.
2.	Jacob Millman, Christos C. Halkias, SatyabrataJit, "Electronic Devices and Circuits", 4th Edition, McGraw-Hill, New Delhi, 2015.
3.	Bell, David A., "Solid State Pulse Circuits", 4th Edition, Prentice Hall of India, New Delhi, 1992, ISBN: 97801382977893.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	comprehend the construction and characteristics of various electronic devices	Understanding(K2)
CO2	design various biasing circuits of BJT	Applying (K3)
CO3	analyze transistor amplifier circuits using small signal h-parameter model	Analyzing (K4)
CO4	analyze the frequency response of amplifiers using hybrid $\pi$ model	Analyzing (K4)
CO5	design various power supply circuits	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1				2							3	2
CO2	3	2	1	1	2			2				2	3	2
CO3	3	3	2	2									2	
CO4	3	3	2	2									2	
CO5	3	2	1	1	2	2		2				2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	30	40			100
CAT3	10	30	30	30			100
ESE	10	30	30	30			100

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

**20ECT33 - SIGNALS AND SYSTEMS**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	3	1	0	4

Preamble	This course provides the foundations for understanding the various types of signals and 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	Time Domain Analysis of CT and DT:	9+3
Sampling of continuous time signals- Convolution integral and convolution sum -properties of convolution- Impulse response of a system- step response of a system- Graphical procedure for convolution - Interconnection of systems.		
Unit - III	Real Frequency Domain Analysis:	9+3
Complex exponential Fourier series analysis – Gibbs phenomenon-Fourier Transform: CTFT- Properties - Response of LTI CT systems, DTFT – Properties - Response of LTI DT systems. Inverse Fourier Transform for CT and DT Signals.		
Unit - IV	Laplace Transform (LT):	9+3
Relation between CTFT and LT- Region of Convergence- LT of CT signals- Properties - Response of LTI-CT systems- Impulse response- Step response- Inverse Laplace Transform.		
Unit - V	Z-transform (ZT):	9+3
Relation between DTFT and ZT - Region of Convergence- ZT of DT signals- Properties - Response of LTI-DT systems- Impulse response- Step response- Inverse Z-transform using partial fraction and residue method - Realization of DT systems using direct form I and II.		

**Lecture:45, Tutorial:15, Total:60****TEXT BOOK:**

1. Oppenheim Alanv, Willsky Alan S., Hamid Nawab S., “Signals & Systems”, 2<sup>nd</sup> Edition, Pearson Education, New Delhi, 2015.

**REFERENCES:**

1. Nagoor Kani A., “Signals and Systems”, 23<sup>rd</sup> Reprint, McGraw-Hill, New Delhi, 2019.
2. Roberts M.J., “Signals And Systems Analysis Using Transform Method and Matlab”, 3<sup>rd</sup> Edition, Tata McGraw-Hill, New Delhi, 2018.





<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	illustrate the continuous time and discrete time signals and systems	Applying (K3)
CO2	solve the system response for I and II order systems	Applying (K3)
CO3	apply Fourier transform techniques and plot the spectrum	Applying (K3)
CO4	utilize Laplace transform and solve continuous time system response	Applying (K3)
CO5	apply Z-transform on discrete time systems and solve the system response	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	2	1	1	2	1			2	2		2		
CO2	3	2	1	1	2	1			2	2		2	3	
CO3	3	2	1	1	2	2			2	2		2	3	
CO4	3	2	1	1	2	2			2	2		2	3	
CO5	3	2	1	1	2	2			2	2		2	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	20	40	40				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)

**20ECL31 - DIGITAL ELECTRONICS LABORATORY**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>3</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To design combinational and sequential logic circuits.						

**List of Exercises / Experiments:**

1.	Verification of Boolean theorems and digital logic gates
2.	Design and implementation of combinational circuits using logic gates
3.	Design and implementation of adder and subtractor
4.	Design and implementation of encoders and decoders.
5.	Design and simulation of adder, subtractor, encoders and decoders
6.	Design and simulation of multiplexers, demultiplexers and code converters
7.	Design and simulation of magnitude comparator
8.	Design and implementation of flip flops using basic gates.
9.	Design and implementation of shift registers in SISO, SIPO, PISO, PIPO modes using suitable ICs.
10.	Design and implementation of synchronous counters and asynchronous counters.
11.	Mini project using Combinational circuits and sequential circuits

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

1.	Laboratory Manual
2.	Modelsim

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	design and verify combinational circuits using logic gates	Applying(K3), Precision (S3)
CO2	design and simulate combinational circuits using Verilog HDL	Applying(K3), Precision (S3)
CO3	design and test sequential circuits using flipflops	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				3	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

**20ECL32 - SOLID STATE DEVICES AND CIRCUITS LABORATORY**

<b>Programme &amp; Branch</b>	<b>B.E. &amp; Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	NIL	<b>3</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To verify the characteristics of devices and design amplifiers & power supply circuits						

**List of Experiments :**

1.	Characteristics of PN Junction diode and Zener diode
2.	Characteristics of FET
3.	Characteristics of UJT
4.	Characteristics of SCR and TRIAC
5.	Characteristics of BJT(Common Emitter Configuration) and Determination of h-Parameters
6.	Frequency response of BJT amplifiers with fixed bias / voltage divider bias / collector to base bias
7.	Frequency response of Darlington Pair
8.	Frequency response of multistage amplifiers
9.	Construction and working of bridge rectifier using diode with and without capacitor filter
10.	Simulation of a) Characteristics of BJT b) Frequency response of Voltage Divider Bias (BJT)
11.	Frequency response of common-collector amplifier using PSpice
12.	Frequency Response of Cascode Amplifier using PSpice

**Total:30****REFERENCES/MANUALS/SOFTWARE:**

1.	Laboratory Manual
2.	Orcad Cadence PSpice Software 16.6

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	demonstrate the characteristics of various electronic devices	Applying (K3), Precision (S3)
CO2	design various biasing circuits for electronic systems	Applying (K3), Precision (S3)
CO3	perform simulation of the frequency response of amplifiers 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	1	3	3	2			3	3		2	2	2
CO2	3	2	1	3	3	2	2		3	3		2	3	2
CO3	3	2	1	3	3				3	3		2	2	

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



Kongu Engineering College, Perundurai, Erode – 638060, India

## 20EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION LABORATORY

(Common to all BE/BTech Engineering and Technology branches)

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	3 / 4	HS	0	0	2	1

<b>Preamble:</b>	This course is designed to impart required levels of fluency in using the English Language at B1/B2 level in the CEFR through activities, hands-on training and application.	
<b>Unit -I</b>	<b>Listening:</b>	<b>6</b>
Techniques for effective listening and note taking; listening to audio scripts, podcasts and TED talks; listening to discourse samples of native speakers and imitating; improving pronunciation; introduction to the basics of phonetics and understanding different accents.		
<b>Unit -II</b>	<b>Reading:</b>	<b>6</b>
Speed reading skills; reading to gain knowledge; reading newspaper articles to improve writing; academic journals to enrich vocabulary and word power; reading aloud with proper stress and intonation; reading to draw inferences.		
<b>Unit -III</b>	<b>Soft Skills:</b>	<b>6</b>
Importance of soft skills at workplace - understanding soft skills through case studies - developing positive attitude; goal setting; time management; team work; telephone etiquette; developing professionalism, interpersonal skills and work ethics.		
<b>Unit -IV</b>	<b>Writing:</b>	<b>6</b>
Introduction to pre-writing, style and mechanics of writing; mind mapping; creating content from an outline; paragraph and resume writing; nuances of academic writing; writing Statement of Purpose (SOP), editing, revising and proof reading for clarity and readability; structural and grammatical accuracy.		
<b>Unit -V</b>	<b>Speaking:</b>	<b>6</b>
Verbal and non-verbal communication; fluency and spoken English; introducing oneself and others; making presentations on topics using prepared material; mock interviews; dynamics of Group Discussion.		

### List of Exercises / Experiments :

1.	Mock Interview
2.	Presentation
3.	Reading Aloud
4.	Group Discussion
5.	Soft Skills through Case Studies
6.	Listening Test

**Total: 30**

### REFERENCES/MANUAL/SOFTWARE:

1.	Jeff Butterfield, "Soft Skills for Everyone", 1 <sup>st</sup> Edition, Cengage Learning, New Delhi, 2011 for units
2.	Bob Dignen, Steve Flinders and Simon Sweeney, "Professional English for Work and Life, English 365, Student's Book 2", 1 <sup>st</sup> Edition, Cambridge University Press, New Delhi, 2004 for unit

COURSE OUTCOMES:		BT Mapped (Highest Level)
On completion of the course, the students will be able to		
CO1:	acquire effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2:	acquire and demonstrate appropriate professional skills for the workplace	Applying (K3), Naturalization (S5)
CO3:	speak fluently and write meaningfully in English in the given context	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	PSO1	PSO2
CO1									2	3		2		
CO2									2	3		2		
CO3									3	3		3		

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



**20GET31 - UNIVERSAL HUMAN VALUES**  
(Common to All BE/BTech branches)

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3 / 4	HS	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.
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**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.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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				
CO4						3	3	3	3	3				
CO5						3	3	3	3	3				
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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
CAT3	NA						
ESE	NA						

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

**20MAT43 - PROBABILITY THEORY AND STOCHASTIC PROCESS**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>4</b>	<b>BS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

Preamble	To impart knowledge in random variables, probability distributions, correlation, linear systems and apply the concepts of random process and spectral densities in communication engineering.	
Unit - I	Random Variables and Probability distributions:	9+3
Introduction to Probability - Random Variables - Discrete and Continuous random variables – Moments – Moment generating functions. Standard Probability Distributions: Discrete Distributions: Binomial distribution – Poisson distribution – Continuous Distributions: Exponential distribution – Normal distribution.		
Unit - II	Two Dimensional Random Variables:	9+3
Two Dimensional Random Variables: Joint probability distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Function of random variables – Transformation of random variables.		
Unit - III	Random processes:	9+3
General concepts and definitions – Classification – Stationary process – Markov chains – Transition probabilities – Limiting distributions – Poisson process.		
Unit - IV	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 - V	Linear Systems with Random Inputs:	9+3
Linear system Fundamentals - Random Signal Response of Linear Systems –Spectral Characteristic of System Response – Power density spectrum of response – System Evaluation using Random noise - Noise Bandwidth – Band pass – Band limited – Narrow Band Processes.		

**Lecture: 45, Tutorial: 15, Total: 60****TEXT BOOK:**

1.	Veerarajan, T, "Probability, Statistics, Random Processes and Queuing Theory", 1st Edition, Tata McGraw-Hill, New Delhi, 2019.
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**REFERENCES:**

1.	Peebles P.Z., "Probability, Random Variables and Random Signal Principle", 4 <sup>th</sup> Edition, McGraw Hill, New Delhi, India, 2017.
2.	Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", 2 <sup>nd</sup> Edition, Academic Press, Elsevier, USA, 2014.
3.	Roy.D.Yates and David.J.Goodman, "Probability and Stochastic Processes - A friendly introduction for Electrical and Computer Engineers", 3 <sup>rd</sup> Edition, John Wiley & Sons, USA, 2014.
4.	Stark H. and Woods J.W., "Probability and Random Processes with Applications to Signal Processing", 3 <sup>rd</sup> Edition, Prentice Hall, 2002.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understand the fundamental concepts of random variables and apply suitable probability distributions in engineering problems.	Applying (K3)
CO2	understand the concepts of two dimensional random variables and regression.	Applying (K3)
CO3	interpret the temporal characteristics of random process.	Applying (K3)
CO4	apply the concepts of spectral densities and correlation functions to solve complex engineering problems.	Applying (K3)
CO5	apply the random process concepts to linear time invariant systems.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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	1										
CO4	3	2	1											
CO5	3	2	1											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	25	65				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)



**20CSC41 – PYTHON PROGRAMMING****(Common to all BE/BTech Engineering & Technology branches except CSE, IT )**

Programme & Branch	All BE/BTech Engineering & Technology branches except CSE, IT	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	ES	3	0	2	4

Preamble	This course introduces the core python programming. It emphasizes on developing python programs with all data types, functions, classes, objects and numpy	
Unit - I	Introduction:	9
Introduction: 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,Tuples and Dictionary: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 and Regular Expressions: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 and Modules: 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, NumPy and Matplotlib:	9
Object Orientation: Class and Objects:Class and objects – class methods and self – constructor – class and object variables – destructor – public and private data member.NumPy :NumPy Arrays – Computation on NumPy Arrays. Matplotlib : Line plots – Scatter Plots		

**List of Exercises / Experiments :**

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", 3 <sup>rd</sup> Edition, Oxford University Press, 2017.
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**REFERENCES:**

1.	Nageswara Rao, "Core Python Programming", 2 <sup>nd</sup> Edition, DreamTech Press, New Delhi, 2018.
2.	Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", 1 <sup>st</sup> Edition, O'Reilly Media, , 2016.

**COURSE OUTCOMES:**

On completion of the course, the students will be able to

**BT Mapped  
(Highest Level)**



CO1	understand the basics of python programming using nested and control statements	Understanding (K2)
CO2	apply list, tuple and dictionary to handle variety of data	Applying(K3)
CO3	apply strings and regular expression for searching in a string.	Applying(K3)
CO4	solve the problems using functions and modules	Applying(K3)
CO5	understand the object oriented concepts and perform data science operations for applications	Applying(K3)
CO6	implement the basic data types and control statements	Applying (K3), Precision(S3)
CO7	demonstrate functions, regular expressions and object oriented concepts	Applying (K3), Precision(S3)
CO8	perform numpy operations and analyse results using matplotlib	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		2			2	2		2		
CO5	3	2	1	1		2			2	2		2		
CO6	3	2	1	2	2	2			2	2		2		
CO7	3	2	1	2	2	2			2	2		2		
CO8	3	2	1	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	25	25	50				100
CAT2	20	20	60				100
CAT3	20	20	60				100
ESE	25	25	50				100

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

**20ECT41 - ELECTRONIC CIRCUITS**

Programme& Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Solid State Devices and Circuits	4	PC	3	0	0	3

Preamble	To understand and analyze feedback amplifiers, large signal amplifiers, FET amplifiers, oscillators and wave shaping circuits.	
Unit - I	<b>FET Amplifiers:</b>	<b>9</b>
Biasing of FET :Fixed bias, Self-Bias, Voltage Divider Bias-Small Signal Low Frequency Analysis: Common Source and Common Drain Amplifiers-High Frequency Large Signal Amplifiers Analysis: Common Source and Common Drain Amplifiers		
Unit - II	<b>Feedback Amplifiers:</b>	<b>9</b>
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 – Feedback Amplifiers using FET (Identification of topology only)		
Unit - III	<b>Oscillators:</b>	<b>9</b>
Condition for oscillation – RC Oscillators: RC phase shift (using BJT and FET) and Wien Bridge Oscillators - LC oscillators: Hartley and Colpitts oscillator using BJT, Quartz crystal: Construction - Electrical equivalent circuit of crystal - Crystal oscillator circuit: Miller and Pierce oscillators.		
Unit - IV	<b>Large Signal Amplifiers:</b>	<b>9</b>
Classification of amplifiers (Class A, B, AB, and C&D)-Direct coupled and transformer-coupled class A power amplifiers and its efficiency-Distortion in power Amplifiers-Class B complementary-symmetry, push-pull power amplifiers. Calculation of power output, efficiency and power dissipation-Crossover distortion and its elimination methods- Class C amplifiers-operation-applications.		
Unit - V	<b>Multivibrators&amp; Time Base Generators</b>	<b>9</b>
RL Integrator & RC Differentiator circuits - Multivibrators:Collector coupled Astablemultivibrator- Collector coupled Monostablemultivibrator- Bistablemultivibrators- Schmit trigger-Introduction to Voltage time base generator-Errors of generation of sweep waveform- UJT relaxation oscillator .		

**Total:45****TEXT BOOK:**

1.	Jacob Millman, Christos C. Halkias, SatyabrataJit, "Electronic Devices and Circuits", 4th Edition, McGraw-Hill, New Delhi, 2015.
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**REFERENCES:**

1.	Millman J. and Taub H., "Pulse Digital and Switching Waveform", 2 <sup>nd</sup> Edition, McGraw Hill, New York, 2007.
2.	Bell and David A, "Solid State Pulse Circuit", 4 <sup>th</sup> Edition, Prentice Hall of India, New Delhi, 1992.
3.	Allen Mottershead, "Electronic Devices and Circuits - An Introduction", 1 <sup>st</sup> Edition, Prentice Hall of India, New Delhi, 1990.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	analyse the FET biasing circuits, low and high frequency FET amplifiers	Analysing (K4)
CO2	examine the performance of amplifiers using feedback concepts	Analysing (K4)
CO3	design oscillators for various frequencies for practical applications	Applying (K3)
CO4	analyse the performance of large signal amplifiers	Applying (K3)
CO5	design non-sinusoidal oscillators	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1		2				1	3	2
CO2	3	3	2	2	1			2					1	
CO3	3	2	1	1		2						2	1	2
CO4	3	2	1	1								1	3	1
CO5	3	2	1	1								1	3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	20	40			100
CAT2	10	40	25	25			100
CAT3	10	30	30	30			100
ESE	10	30	30	30			100

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

**20ECT42 - MICROPROCESSOR AND MICROCONTROLLER**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Electronics	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, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems using Assembly and C”, 2 <sup>nd</sup> 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”, 1 <sup>st</sup> Edition, Pearson Education, New Delhi, 2013.
2.	Patel, “The 8051 Microcontroller Based Embedded Systems”, 1 <sup>st</sup> Edition, McGraw Hill Education, New Delhi, 2014, ISBN : 9789332901254.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
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

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	20	65	15				100
CAT2	20	40	40				100
CAT3	10	35	55				100
ESE	20	30	50				100

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

**20ECT43 - CONTROL ENGINEERING**

Programme& Branch	B.E. - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Matrices and differential equations	4	ES	3	1	0	4

Preamble	To understand the concepts of mathematical modeling of various systems and also to examine the system response and stability of the developed models in both time and frequency domain.						
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<b>Unit - I</b>	<b>System Representation:</b>	<b>9+3</b>
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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.

<b>Unit - II</b>	<b>Time Domain Analysis:</b>	<b>9+3</b>
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Standard test signals- Time response of First and Second order system - 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.

<b>Unit - III</b>	<b>Stability Analysis in time Domain:</b>	<b>9+3</b>
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Characteristics Equation – Location of Roots in S plane for stability – Routh Hurwitz Criterion – Root Locus construction – Effect of poles and zeros on system stability.

<b>Unit - IV</b>	<b>Frequency Response Analysis:</b>	<b>9+3</b>
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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.

<b>Unit - V</b>	<b>State Space Representation:</b>	<b>9+3</b>
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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", 5<sup>th</sup> Edition, New Age International, New Delhi, 2013.

**REFERENCES:**

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



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	develop Mathematical models for various types of control systems.	Applying (K3)
CO2	derive the time response of first and second order controllers	Applying (K3)
CO3	examine the stability of the systems in time domain.	Analyzing (K4)
CO4	make use of plots to interpret the stability of systems in frequency domain.	Analyzing (K4)
CO5	apply various tests to find the controllability and observability for various systems.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1				2	2		2	3	
CO2	3	3	3	2	2				2	2		2	3	
CO3	3	3	3	2	2				2	2		2	3	
CO4	3	3	3	2	2				2	2		2	3	
CO5	3	2	1	1	1				2	2		2	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	35	45				100
CAT2	10	30	40	20			100
CAT3	5	25	50	20			100
ESE	10	20	60	10			100

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



**20ECL41 - ELECTRONIC CIRCUITS LABORATORY**

<b>Programme&amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	Solid State Devices and Circuits	<b>4</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To design amplifiers, oscillators and multivibrators.						

**List of Exercises / Experiments :**

1.	Frequency response of common source amplifier using self bias
2.	Frequency response of current series feedback amplifier using BJT
3.	Frequency response of Voltage series feedback amplifier using FET
4.	Design of audio frequency oscillator: RC Phase Shift Oscillator using BJT
5.	Design of radio frequency oscillator: Hartley oscillator / Miller Oscillator using BJT
6.	Response of Class -B Complementary symmetry Power amplifier-with and without crossover distortion
7.	Design of Class C tuned Amplifier using BJT
8.	Design of Bistable multivibrator using BJT
9.	Design of Astable multivibrator using BJT
10.	Design of UJT relaxation oscillator
11.	Simulation using PSpice : Frequency response of current shunt / voltage shunt feedback amplifier using BJT/FET
12.	Simulation using PSpice : Wien Bridge Oscillator/ Colpitts Oscillator using BJT/FET

**Total:30****REFERENCES/MANUALS/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	construct feedback and large signal amplifiers using BJT and FET for the given specifications	Applying (K3), Precision (S3)
CO2	demonstrate the working of, oscillators (RC,LC) and multivibrators	Applying (K3), Precision (S3)
CO3	design the 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	3	2	3				2					
CO2	3	2	1	3	3				2				2	2
CO3	3	3	2	3	3				2				1	

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

**20ECL42 - 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 Exercises / Experiments :**

1.	Arithmetic operations using 8086
2.	Sorting, searching and string manipulation using 8086
3.	Matrix multiplication using 8086 microprocessor
4.	BCD code conversion using 8086 microprocessor
5.	Arithmetic operations using 89C51 microcontroller.
6.	Interfacing of switch and LED with 89C51 microcontroller.
7.	Interfacing of ADC with 89C51 microcontroller.
8.	Interfacing of DAC with 89C51 microcontroller.
9.	Stepper Motor interfacing with 89C51 microcontroller.
10.	DC Motor interfacing with 89C51 microcontroller
11.	UART communication in 89C51 microcontroller using Keil and Proteus
12.	LCD interfacing with 89C51 microcontroller using Keil and Proteus

**Total:30****REFERENCES/MANUAL/SOFTWARES:**

1.	Laboratory Manual
2.	Keil and Proteus software

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply 8086 and 8051 instruction sets and addressing modes for a given addition / Subtraction / Multiplication / Division / sorting and code conversions 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 of serial communication and LCD Interfaces using 8051 Microcontroller	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
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		
CO3	3		3		1				3	2		2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

**20MNT31 - ENVIRONMENTAL SCIENCE**

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3 / 4	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-Value 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 BOOK:**

1.	Anubha Kaushik, and Kaushik C.P., “Environmental Science and Engineering”, 6th Multicolour Edition, New Age International Pvt. Ltd., New Delhi, 2018 for unit
2.	Lodish. H., Berk A., Zipurursky S.L., Matsudaria P., Baltimore D. and Darnell J., “Molecular Cell Biology”, 4 <sup>th</sup> Edition, Freeman Press, 2000 for unit

**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.	Satyanarayan, U.,& Chakrapani, U., “Textbook of Biochemistry”, 1999 Ed. June 2017



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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														

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

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

**20ECT51 - 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- Blocking and non blocking statements- delay control- event control, conditional statements- multiway branching-loops- Switch level modeling - Tasks and Function		
Unit - II	Logic Synthesis and RTL Design:	9
Logic Synthesis- Impact of Logic Synthesis- Verilog HDL Synthesis- Synthesis Design Flow- Modeling Tips for Logic Synthesis- RTL Design- 4-bit full adder subtractor- ALU Design – Booth Multiplication- GCD Computation.		
Unit - III	MOS Transistor:	9
CMOS Logic- MOS Transistor Theory- Long Channel I-V characteristics- C-V characteristics- Nonideal I-V effects-DC characteristics-- Power dissipation – Switching Characteristics.		
Unit - IV	MOS Fabrication:	9
An overview of silicon semiconductor technology - Basic CMOS technology: Nwell- 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 BOOK:**

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

**REFERENCES:**

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



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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 and techniques used for VLSI fabrication	Understanding (K2)
CO4	make use of layout design rules to draw layout of logic functions and to design circuits using various logic styles..	Applying (K3)
CO5	apply various testing techniques/algorithms to test circuits	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		1			3				1	1	3
CO2	3	2	2		1			3				1	1	3
CO3	3				1							1		2
CO4	3	2	2		1			3				1	1	3
CO5	3	2						2				2		1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	60	30				100
CAT3	20	60	20				100
ESE	10	50	40				100

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

**20ECT52 - DIGITAL SIGNAL PROCESSING**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Signals and system	5	PC	3	0	0	3

Preamble	To design and analyze digital signal processing systems and implement in DSP processors.	
Unit - I	DFT and FFT	9
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.		
Unit - II	FIR Filter Design:	9
Response of FIR Filter – Group delay & phase delay- Non-Causal Filter design - Causal Filter Design using : Rectangular –Hamming –Hanning- Blackmann Window-Frequency sampling technique.		
Unit - III	IIR Filter Design:	9
Analog filter design: Butterworth filter and Chebyshev type-I filters - Digital Transformation : Impulse invariance technique – Bilinear transformation		
Unit - IV	Finite Word Length Effect:	9
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.		
Unit - V	DSP Processor and its Implementation	9
Introduction to programmable DSPs –TMS320C67xx –Features and options-Architecture of C67X –Memory organization-CPU –Introduction to debugging using Code Composer Studio.		

**Total:45****TEXT BOOK:**

1.	Alan V. Oppenheim & Ronald W. Schafer, "Discrete Time Signal Processing", 2 <sup>nd</sup> Edition, Pearson education, New Delhi, 2010.
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**REFERENCES:**

1.	NagoorKani, "Digital Signal Processing", 2 <sup>nd</sup> Edition, McGraw-Hill, New Delhi, 2017.
2.	Proakis John G & ManolakisDimtris G, "Digital Signal Processing: Principles, Algorithms and Applications", 4 <sup>th</sup> Edition, PHI Learning, New Delhi, 2018.
3.	Venkataramani. B & Bhaskar M, "Digital Signal Processor Architecture, Programming and Application", 2 <sup>nd</sup> Edition, McGraw-Hill, 2002.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply DFT and FFT to find frequency components in a signal.	Applying (K3)
CO2	design digital FIR filter for the given specification	Applying (K3)
CO3	design digital IIR filter for the given specification.	Applying (K3)
CO4	determine the effect of finite word length of infinite response	Applying (K3)
CO5	interpret DSP Processor architecture and its Implementation	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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				3	
CO3	3	2	2	2					2				3	
CO4	3	2	2	2										
CO5	3	3	2	2	3				2				3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30				100
CAT2	20	20	60				100
CAT3	10	40	50				100
ESE	15	35	50				100

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



**20ECT53 - LINEAR INTEGRATED CIRCUITS**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Solid State Devices and Circuits</b>	<b>5</b>	<b>PC</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To explore the analog systems using op-amp and special function ICs	
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:	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.		

**TEXT BOOK:**

1.	Roy Choudhry D. & Shail B. Jain, "Linear Integrated Circuits", 5 <sup>th</sup> Edition, New Age International, New Delhi, 2018.
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**REFERENCES:**

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



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	elaborate the need of various current sources circuits for improving CMRR and the DC and AC characteristics of operational amplifier.	Understanding (K2)
CO2	develop different applications of operational amplifiers for the given specification.	Applying (K3)
CO3	construct I, II order low pass and high pass filters, rectifiers and regulators.	Applying (K3)
CO4	model the different types of A/D and D/A converters.	Applying (K3)
CO5	elucidate the astable and monostable multivibrator operation and understand the working principle of PLL and VCO.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2											
CO2	3	3	2	2	2	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														

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

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

**20ECL51 - VLSI DESIGN LABORATORY**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Digital Electronics</b>	<b>5</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To design and implement digital circuits using Verilog Hardware Description Language						

**List of Exercises / Experiments :**

1.	Design of 16x1 multiplexer using structural modeling.
2.	Design of 8 bit carry look ahead adder and BCD adder
3.	Modeling of Sequential Digital Systems
4.	Modeling of State Machine Design
5.	Modeling of Memory Design
6.	Design of 4 * 4 array multiplier using structural modeling
7.	Design and implementation of 4-bit Adder-Subtractor Unit
8.	Design and implementation of ALU
9.	Design and implementation of Booth multiplier
10.	Design and implementation of Real Time Clock
11.	Design of Full adder using CMOS transistor
12.	Design of D-Flipflop using CMOS transistor

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

1.	Laboratory Manual
2.	Modelsim, Xilinx and any SPICE Package

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	design 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	1	1	2				3			3	3	3
CO2	3	2	1	1	2				3			3	3	3
CO3	3	2	1	1	2				3			3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

**20ECL52 - DIGITAL SIGNAL PROCESSING LABORATORY**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Signals and system	5	PC	0	0	2	1
Preamble	To simulate and analyze the frequency components of a signal, digital filters and its implementation using DSP processors						

**List of Exercises / Experiments :**

<b>Using MATLAB</b>	
1.	Generation of signals & basic operation on signals
2.	Perform Convolution using FFT and IFFT
3.	FIR Filter design and its analysis using Windowing method
4.	FIR Filter design and its analysis using Frequency sampling technique
5.	Digital IIR Filter design and its analysis using impulse invariant method and bilinear transformation technique
<b>Using SIMULINK</b>	
6.	Signal generation and basic operation on signals
7.	Perform FFT for the signal and plot the frequency spectrum
8.	Filter design-FIR and IIR filters
<b>Using DSP PROCESSOR &amp;SIMULINK</b>	
9.	Signal generation and basic operation on signals
10.	Real time signal acquisition and processing in DSP processor

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

1.	Laboratory Manual
2.	MATLAB
3.	Code Composer Studio

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
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	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

**20ECL53 - LINEAR INTEGRATED CIRCUITS LABORATORY**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	Solid State Devices and Circuits	<b>5</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To design amplifiers, oscillators, multivibrators and op-amp based applications.						

**List of Exercises / Experiments :**

1.	Simple Applications of Op-Amp circuits- Inverting and non-inverting amplifiers, Voltage Follower, Differentiator and Integrator
2.	Applications of comparator: Zero crossing detector and Window detector
3.	Design of Schmitt trigger using IC741
4.	Design of RC phase shift oscillator and Wien bridge oscillator using Op-Amps
5.	Design of a second order Butterworth low-pass and high-pass filter for the given higher and lower cutoff frequencies
6.	Plot the characteristics of Half-wave and precision rectifiers using Op-Amps
7.	Examine the characteristics of Voltage regulator using 78xx series
8.	Design of R-2R ladder type Digital to Analog Converter and Flash type Analog to Digital Converter
9.	Design of timer circuits using IC555 in monostable mode.
10.	Mini Project

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

1.	Laboratory Manual
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<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	design the applications of Operational Amplifiers.	Applying (K3), Precision (S3)
CO2	demonstrate the working of special function ICs, IC555 and IC78xx series.	Applying (K3), Precision (S3)
CO3	design and implement real world problems using analog integrated circuits.	Analyzing (K4), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	3	3	2		2			2	2			2	2
CO2	3	3	3	2		2			2	2			2	2
CO3	3	3	3	2	3	3			2	2			2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														



Kongu Engineering College, Perundurai, Erode – 638060, India

**20GEL51 - PROFESSIONAL SKILLS TRAINING I**  
(Common to all BE/ BTech / MSc / MCA /BSc Branches)

Programme & Branch	B.E - Electronics and Communication Engineering	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						
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<b>Unit - I</b>	<b>Soft Skills – I</b>	<b>20</b>
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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.

<b>Unit - II</b>	<b>Quantitative Aptitude &amp; Logical Reasoning - I</b>	<b>30</b>
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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

<b>Unit - III</b>	<b>Written Communication &amp; Verbal Aptitude</b>	<b>30</b>
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Writing Skills: Writing strategies and formats – Importance of Résumés – Writing a Cover letter – Writing a fresher's CV / Résumés – 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: 80**

**TEXT BOOK:**

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6 <sup>th</sup> Edition, Pearson India Education Services Pvt Ltd, 2017.
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**REFERENCES:**

1	Bailey Stephen, "Academic Writing: A practical guide for students", Routledge, New York, 2011.
2	Raman, Meenakshi and Sharma, Sangeeta, "Technical Communication - Principles and Practice", 3 <sup>rd</sup> Edition, Oxford University Press, New Delhi, 2015.

**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 individual and 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						

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

**20ECT61 - ANALOG AND DIGITAL COMMUNICATION**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Signals and Systems, Solid State devices and Circuits</b>	<b>6</b>	<b>PC</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>Preamble</b>	To endow the fundamentals and analytical perspectives of communication systems.	
<b>Unit - I</b>	<b>Amplitude Modulation:</b>	<b>9</b>
Introduction: Modulation and its need– Linear modulation schemes: DSBSC, SSBSC and VSB-power spectrum – Frequency translation – Frequency division multiplexing – Superheterodyne receivers – Noise in AM receivers: coherent detection, envelope detection.		
<b>Unit - II</b>	<b>Angle Modulation:</b>	<b>9</b>
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		
<b>Unit - III</b>	<b>Pulse Modulation and Baseband Pulse Transmission:</b>	<b>9</b>
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 patterns – Nyquist Criterion for distortion less baseband binary transmission – Pulse shaping with raised cosine filter – Duobinary signaling – Adaptive equalization : LMS algorithm		
<b>Unit - IV</b>	<b>Passband Digital Transmission and Spread Spectrum Communication:</b>	<b>9</b>
Introduction – Coherent Phase shift keying: BPSK, QPSK, OQPSK, $\pi/4$ shifted QPSK – QAM- BER analysis of BPSK and QPSK-concepts of MSK-Spread Spectrum: PN sequence and its properties- Direct Sequence Spread Spectrum-Frequency Hopping Spread Spectrum		
<b>Unit - V</b>	<b>Information Theory and Coding:</b>	<b>9</b>
Entropy and its properties – Source coding theorem : Huffman coding, LZ coding – Discrete Memory less Channel – mutual information and its properties – Channel coding theorem – information capacity theorem; Hamming codes – Convolutional codes – Trellis diagram– Viterbi algorithm – Trellis coded modulation :8 ary PSK		

**Total:45****TEXT BOOK:**

1. Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communications", 2<sup>nd</sup> Edition, John Wiley & Sons, New Delhi, 2012.

**REFERENCES:**

1. Simon Haykin, "Digital Communication Systems", 2<sup>nd</sup> Edition, John Wiley, New Delhi, 2014.
2. GautamSahe, Taub & Schilling, "Principles of Communication Systems", 4<sup>th</sup> Edition, McGraw-Hill, New Delhi, 2007.





<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	apply the concept of amplitude modulation and infer the effect of noise in AM receivers	Applying (K3)
CO2	make use of the concept of narrowband and wide band FM and interpret the effect of noise in FM receivers	Applying (K3)
CO3	identify the notion of baseband pulse transmission, inter-symbol interference and its compensation methods	Applying (K3)
CO4	apply the scheme of passband digital transmission for band limited and wideband signals	Applying (K3)
CO5	inspect the characteristics of discrete memory less channel and provide the solution for lossless, error free communication	Analyzing (K4)

<b>Mapping of COs with POs and PSOs</b>														
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	2	2	2	2	
CO5	3	3	2	2	2				2	2		2	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	65	25				100
CAT2	15	65	20				100
CAT3	10	50	30	10			100
ESE	10	55	25	10			100

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

**20ECT62 - 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 (LL):	9
Linear Block Codes - Cyclic Codes – Checksum - Stop and Wait - Go-Back-N - Selective Repeat – Point to Point Protocol – Random Access :CSMA/CD, CSMA/CA-IEEE 802.3 - Gigabit Ethernet - IEEE 802.11- WLAN.		
Unit - III	Network Layer:	9
IPv4 Addressing and Datagram format- IPV6 Addressing and Datagram format - Sub-netting - Address mapping: ARP and RARP – Internet Control Message Protocol - Routing Protocols: DVR , LSR, BGP, OSPF and RIP.		
Unit - IV	Transport Layer:	9
Process-To-Process Delivery – UDP - TCP - Packet format – Services - Error and flow control - Congestion Control in TCP – QoS Parameters- Techniques to improve QoS- Token Bucket and Leaky Bucket.		
Unit - V	Application Layer:	9
E-Mail: Architecture, User Agent, MTA:SMTP,MAA:POP and IMAP- File Transfer Protocol(FTP) - Voice over IP(VoIP): SIP, H.323 and Domain Name System (DNS) : Name Space, Domain Name Space, Distribution of name space, DNS in the internet, DHCP, Cryptography: security attacks-plain text-chipper text, symmetric key ciphers : substitution, transposition ciphers		

**Total:45****TEXT BOOK:**

1. Behrouz A. Forouzan, "Data communication and Networking", 5<sup>th</sup> Edition, Tata McGraw Hill, New Delhi, 2019.

**REFERENCES:**

1. James F. Kurose & Ross Keith W, "Computer Networking: A Top-Down Approach Featuring the Internet", 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2012.
2. Tanenbaum, Andrew S & David Wetherall, "Computer Networks", 5<sup>th</sup> Edition, PHI Learning, New Delhi, 2010.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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.	Analyzing (K4)
CO4	apply suitable protocols for connection oriented and connectionless services in internet.	Applying (K3)
CO5	interpret the functionalities of application protocols.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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								1	3	3
CO3	3	3	2	2	1							2	3	3
CO4	3	2	1	1								1	3	3
CO5	2	1											3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20ECT63 - MICROWAVE AND OPTICAL COMMUNICATION**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>NIL</b>	<b>6</b>	<b>PC</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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.		
Unit - II	Microwave Semiconductor Devices and Vacuum Tubes:	9
Gunn diode-Gunn effect-RWH theory – Avalanche transit time devices - Read diode– TRAPATT diodes - Reflex klystron: Velocity modulation - Power output - Efficiency and electronic admittance-Magnetron: Cylindrical magnetron.		
Unit - III	Microstriplines 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, diodes and mixers.		
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 - 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****TEXT BOOK:**

1.	Samuel Y. Liao, "Microwave Devices & Circuits", 3 <sup>rd</sup> Edition, Pearson Education, New Delhi, 2015 for units I,II & III
2.	Gerd Keiser, "Optical Fiber Communication", 5 <sup>th</sup> Edition, McGraw Hill, New Delhi, 2020 for units IV & V.

**REFERENCES:**

1.	Annapurna Das & Sisir K. Das, "Microwave Engineering", 3 <sup>rd</sup> Edition, McGraw Hill Inc, New Delhi, 2019.
2.	John M. Senior, "Optical Fiber Communication", 3 <sup>rd</sup> Edition, Pearson Education, New Delhi, 2010.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	comprehend the features and characteristics of microwave components.	Understanding (K2)
CO2	illustrate the principles for the measurement of microwave signal parameters.	Understanding(K2)
CO3	apply the principles involved in microstrip lines and mixers for communication.	Applying(K3)
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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	
CO2	3	2	2	1		2		1						1
CO3	2	1	2		2	3					2		1	1
CO4	2	1					3					1	2	1
CO5	2	1						1			1	3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					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)

**20ECL61 - ANALOG AND DIGITAL COMMUNICATION LABORATORY**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Signals and Systems, Solid State Devices and Circuits</b>	<b>6</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To build a firm foundation on analog and digital communication systems.						

**List of Exercises / Experiments :**

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

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

1.	Laboratory Manual
2.	MATLAB
3.	WiComm – T Kit/USRP Kit

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	examine the analog modulation and analog to digital pulse conversion	Analyzing (K4), Manipulation (S2)
CO2	analyze the passband digital modulation	Analyzing (K4), Manipulation (S2)
CO3	Infer the performance of source coding and channel coding	Analyzing (K4), Manipulation (S2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3						2	2	2	
CO2	3	3	2	2	3				3	2	2	2	2	
CO3	3	3	2	2	3				3	2	2	2	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

**20ECL62 - DATA COMMUNICATION AND NETWORKING LABORATORY**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>NIL</b>	<b>6</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To gain a hands-on experience in the field of computer networking such as creating different network topologies, network protocol implementation and analysing the performance using standard metrics						

**List of Exercises / Experiments :**

1.	Design and implement network topologies: Star, Bus, Mesh, Ring
2.	Analyze the functioning of ARQ mechanism: Stop & Wait, GoBack N and Selective Repeat
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 UDP: Server-Client Model
7.	Realization of TCP ON-OFF Applications in client server model
8.	Realization of TCP: Bulk Transfer Applications in client server model
9.	Creation of Dumbbell and Parking lot topologies for TCP and UDP traffic
10.	Packet capture and analysis using network protocol analyzer
11.	Realization of Symmetric key cryptographic algorithm

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

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

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

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
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														



<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>NIL</b>	<b>6</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Preamble</b>	To measure and analyze the microwave and optical parameters						

**List of Exercises / Experiments :**

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.	Measurement of EMI interference using lop periodic antenna.
10.	Observe the VI & PI characteristics of APD/PD.
11.	Analyze the signal characteristics and S-Parameter of power amplifier.
12.	Observe the effective refractive index of the optical fiber using MATLAB.

**Total:30****REFERENCES/MANUAL/SOFTWARE:**

1.	Laboratory Manual
2.	HFSS, ADS, MATLAB

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	describe the performance of microwave oscillators and its signal parameters using a microwave set-up.	Applying(K3), Manipulation (S2)
CO2	illustrate the characteristics of Magic Tee and microstrip transmission lines, S-parameter of power amplifier and mixers.	Applying(K3) Precision (S3)
CO3	observe the characteristics of optical source, fibre and detector.	Applying(K3) Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	2	1				1		3					
CO2	3	2	3		3				3		2	2	2	3
CO3	3	2	3		3		1		3		2	2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														





**20GEL61/20GEI61 PROFESSIONAL SKILLS TRAINING II/ Industrial Training II**  
**(Common to all BE/ BTech / MSc/ MCA /BSc Branches)**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	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 & 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. Logical reasoning: 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/skimmming 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: 80**

**TEXT BOOK:**

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6 <sup>th</sup> Edition, Pearson India Education Services Pvt Ltd, 2017.
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**REFERENCES:**

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



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and 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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	3	3	0	3	0	3	2		
CO2	3	2	0	0	0	3	3	0	3	0	3	2		
CO3	0	2	0	0	0	3	3	0	3	3	3	2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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							

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



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20GEP61 - COMPREHENSIVE TEST AND VIVA**  
 (Common to all BE/BTech branches)

<b>Programme &amp; Branch</b>	<b>All BE/BTech branches</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>6</b>	<b>EC</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	demonstrate knowledge in their respective programme domain.	Applying (K3)
CO2	defend any type of interviews, viva-voce, and aptitude tests conducted for career progression	Applying (K3)
CO3	exhibit professional etiquette and solve related engineering problems	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	3	2	2					1	2	2	3	3	2
CO2	3	3	2	2					1	2	2	3	3	2
CO3	3	3	2	2					1	2	2	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECP61 - PROJECT WORK I PHASE I**

<b>Programme &amp; Branch</b>	<b>B.E. &amp; Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>6</b>	<b>EC</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**Total: 60**

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
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														



**20GET71 - ENGINEERING ECONOMICS AND MANAGEMENT**

(Common to All BE/BTech Engineering And Technology Branches except Chemical Engineering)

Programme & Branch	All BE/BTech branches except Chemical Engineering	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", 1 <sup>st</sup> Edition, McGraw Hill Education, Noida, 2013.
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**REFERENCES:**

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



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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	1	2
CO2		1	2			2	2	2	2	2	3	2	1	2
CO3	1	2	1			2		2	2	2	3	2	2	2
CO4	1	2	1			2		2	2	2	3	2	1	2
CO5	2	2				2		2	2	2	3	2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20ECT71 - ANTENNAS AND WAVE PROPAGATION**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Electromagnetic Fields	7	PC	3	0	2	4

Preamble	To design and analyze the state of the art in antenna based on fundamental principle and understand its parameter measurements.
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<b>Unit - I</b>	<b>Fundamentals of Antenna:</b>	<b>9</b>
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Radiation from Hertzian- Power radiated and radiation resistance, half-wave dipole– Power radiated and radiation resistance — Definitions: Radiation intensity – Directive gain – Directivity – Power gain – Beam width – Bandwidth – Gain, Folded dipole – Baluns- Effective length and effective area – Relation between maximum aperture and gain, Transmission between two antennas

<b>Unit - II</b>	<b>Antenna Arrays:</b>	<b>9</b>
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Expression for electric field from two element arrays: Broadside and endfire array–Uniform linear array–Method of pattern multiplication –Binomial array- Yagi Uda antenna, Log periodic dipole array, Smart antennas

<b>Unit - III</b>	<b>Special and Aperture Antennas:</b>	<b>9</b>
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Helical antenna: Normal mode and axial mode of radiation, Horn antenna, Babinet's principle and complementary antennas, Slot antennas, Antenna with Parabolic reflectors, Microstrip patch antenna: Rectangular patch: transmission line model design procedure

<b>Unit - IV</b>	<b>Propagation of Radio Waves:</b>	<b>9</b>
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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

<b>Unit - V</b>	<b>Antenna Measurements:</b>	<b>9</b>
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Antenna Measurement Ranges- Antenna impedance measurement– Radiation Pattern measurements–Measurement of Antenna gain – Measurement of Radiation resistance – Antenna efficiency – Polarization

**List of Exercises / Experiments :**

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

**Lecture:45, Practical:30, Total:75****TEXT BOOK:**

1.	Prasad K.D, "Antennas and Wave Propagation", 4th Edition, SatyaPrakashan Publications, New Delhi, 2019.
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**REFERENCES/MANUALS/SOFTWARES:**

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



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	infer the concept of antenna parameters and its terminologies	Understanding (K2)
CO2	illustrate the performance of antenna array with its radiation pattern	Applying (K3)
CO3	interpret the characteristics of special antennas	Applying (K3)
CO4	describe the different types of wave propagation effects on the atmospheric layers	Understanding (K2)
CO5	comprehend the importance of antenna parameter measurements	Understanding (K2)
CO6	demonstrate the radiation performance of dipole, helical and yagiuda antenna using antenna chamber	Applying (K3), Precision (S3)
CO7	design and simulate the microstrip patch antenna and its array characteristics	Applying (K3), Precision (S3)
CO8	observe the characteristics of antenna using VNA	Applying (K3), Manipulation (S2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1									1	1
CO3	3	2	1	1									1	1
CO4	2	1												
CO5	2	1												
CO6	3	2	1	1					3					1
CO7	3	2	1	1	3				3				3	3
CO8	3	2	1	1	3				3					1

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

<b>ASSESSMENT PATTERN - THEORY</b>							
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)





Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECP71 - PROJECT WORK II PHASE I**

<b>Programme &amp; Branch</b>	<b>B.E. &amp; Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>7</b>	<b>EC</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>3</b>

**Total: 90**

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
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														

**20ECP81 - PROJECT WORK II Phase II**

Programme & Branch	B.E. & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	---	8	EC	0	0	14	7

**Total: 210**

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

**20ECE01 - TRANSMISSION LINES AND WAVEGUIDES**

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

Preamble	To acquire the concepts of different types of transmission lines with its parameters and gains a complete understanding of stub matching and its design using smith chart. Also understands the concepts of wave propagation in different 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 $Z_0$ - 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
<b>Rectangular Waveguides:</b> Field equations, TM waves, TE waves, Characteristic of TE and TM Waves, Impossibility of TEM waves, Dominant mode, Characteristic impedance ,Excitation of modes. <b>Resonators:</b> Microwave cavity resonator ,Rectangular cavity resonators ,Q factor of a cavity resonator forTE101 mode.		

**Total:45****TEXT BOOK:**

1. Ryder J.D, "Networks Lines and Fields", 2<sup>nd</sup> Edition, Pearson Education, New Delhi, 2015.

**REFERENCES:**

1. Raju G.S.N, "Electromagnetic Field Theory and Transmission Lines", 3<sup>rd</sup> Edition, Pearson Education, New Delhi, 2009.
2. Umesh Sinha, "Transmission Lines and Networks", 1<sup>st</sup> Edition, SatyaPrakasan, New Delhi, 2020.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	compute the parameters of transmission lines.	Applying (K3)
CO2	determine the parameter of transmission line at radio frequency and the impedance value for different lengths of line	Applying (K3)
CO3	make use of Smith Chart for design of transmission lines and Stub Matching	Applying (K3)
CO4	compute the field equations, characteristics and performance parameters for guided waves	Applying (K3)
CO5	determine the field equations, characteristics and performance parameters for rectangular waveguides and rectangular cavity resonators.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1				2					3	1
CO2	3	2	1	1				2					3	1
CO3	3	2	1	1				2					3	1
CO4	3	2	1	1									3	1
CO5	3	2	1	1				2					3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	20	20	60				100

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

**20ECE02 - MICROCONTROLLER BASED AUTOMATION**

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

Preamble	Interpret the concepts of microcontroller, display devices and sensors to make an automated embedded product	
Unit - I	Introduction to 8 bit Microcontroller:	6
Architecture of PIC 16F877A- Register file structure -CPU Register- Status Register- Instruction sets- Addressing modes -Simple programs using ALP- Oscillator and reset circuits.		
Unit - II	Memory Organization:	6
Program memory- Data memory- On-chip Peripherals: Timers-Compare-Capture and PWM Modules- Interrupts-Watchdog timer		
Unit - III	PIC Programming in C:	6
Simple I/O port programming-LED-7 segment – switch-Timer programming – ADC-USART.		
Unit - IV	Case Studies: Boiler and Conveyer	6
Automation in boilers - Temperature, Pressure, Water level-display in LCD-Automation in conveyer based LPG cylinder filling - cylinder count - weight - sealing-display in 7 segment.		
Unit - V	Case Studies: Clock and Electric Vehicle	6
Digital Alarm clock using real time clock interfacing through I2C protocol-time, date, day, alarm time-display in LCD-DC motor based speed and direction control for electric vehicles.		

**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.	Timer interrupt programming in PIC16F877A microcontroller.
5.	Analog sensor interfacing with PIC16F877A microcontroller.
6.	PWM based speed control of DC motor using PIC16F877A microcontroller.
7.	Interfacing of Real Time Clock with PIC 16F877A microcontroller.

**Lecture:30, Practical:30, Total:60****TEXT BOOK:**

1.	Peatman & John B, "Design with PIC Microcontrollers", 1 <sup>st</sup> Edition, Pearson Education, New Delhi, 2009.
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**REFERENCES/MANUALS/SOFTWARES:**

1.	Muhammad Ali Mazidi, Danny Causey, Rolin D McKinlay, "PIC Microcontroller and Embedded Systems: Using Assembly and C For PIC 18", 2 <sup>nd</sup> Edition, Pearson Education, 2021.
2.	Myke Predko, "Programming and customizing the PIC Microcontroller", 3 <sup>rd</sup> Edition, Tata Mcgraw Hill, Delhi, 2008.
3.	Laboratory Manual



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	comprehend the architecture and concepts of PIC microcontroller	Understanding (K2)
CO2	illustrate the working principle of internal peripherals in PIC microcontroller and its applications	Understanding (K2)
CO3	apply embedded C programming skills for on-chip peripherals in real applications using PIC microcontroller	Applying (K3)
CO4	develop embedded C program for automation process in boilers and conveyor based LPG cylinder filling	Applying (K3)
CO5	build embedded C program for digital Alarm clock through I2C protocol and Speed Control using DC motor for electric vehicles.	Applying (K3)
CO6	write efficient embedded C programs for interfacing external peripherals	Applying (K3), Precision (S3)
CO7	write efficient embedded C programs for interfacing internal modules	Applying (K3), Precision (S3)
CO8	design and develop microcontroller based applications using motor and real time clock	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
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	
CO4	3	1	2	2	3	1		2			1	3	3	2
CO5	3	1	2	3	3						1	3	3	2
CO6	3		2		3				2			2	2	
CO7	3		2		3				2			2	2	
CO8	3		1	2	3			2	3		2	2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20ECE03 - 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 -The main amplifier and driver stage		
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 - Temperature telemetry system -Multichannel wireless telemetry system		
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		

**Total:45****TEXT BOOK:**

1. Khandpur R. S, "Handbook of biomedical instrumentation", 3<sup>rd</sup> Edition, McGraw Hill, New Delhi, 2014.

**REFERENCES:**

1. Cromwell Leslie, Weibell Fred J & Pfeiffer Erich A, "Biomedical Instrumentation and Measurements", 2<sup>nd</sup> Edition, Pearson Education, New Delhi, 2015.
2. Reddy D.C., "Biomedical Signal Processing – Principles and Techniques", 1<sup>st</sup> Edition, McGraw Hill, New Delhi, 2008.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	comprehend the physiological systems of the human body	Understanding (K2)
CO2	paraphrase types of electrodes used in measurement of bio signals in recording system	Understanding (K2)
CO3	compute the parameters of human system using the principles of recording and monitoring instruments	Applying (K3)
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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		1							3	
CO2	3	2	1	1		1							3	
CO3	3	2	1	1	1	1							3	
CO4	3	2	1	1		2							3	
CO5	3	2	1	1		1							3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	15	50	35				100
CAT3	20	80					100
ESE	20	60	20				100

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





<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Digital Electronics</b>	<b>5</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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 and Memory Unit:	9
Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired Control - Semiconductor RAMs, ROMs – Speed, size and cost – Cache memories – Mapping functions- Virtual memory – Address translation.		
Unit - IV	Input and Output:	9
External Devices - I/O modules - Programmed I/O - Interrupt-Driven I/O - Direct Memory Access - I/O Channels and Processors		
Unit - V	Computer Peripherals and Multicomputers:	9
Input Devices - Output Devices - Serial Communication Links: Asynchronous Transmission - Synchronous Transmission - Standard Communications - Multicomputers: Local Area Networks - Ethernet Bus - Token Ring - Network of Workstations.		

**Total:45****TEXT BOOK:**

1.	Hamacher Carl, VranesicZvonko & ZakySafwat, "Computer Organization", 5 <sup>th</sup> Edition, McGraw Hill, New Delhi, 2011.
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**REFERENCES:**

1.	Stallings William, "Computer Organization and Architecture: Designing for Performance", 11 <sup>th</sup> Edition, Pearson Education, New Delhi, 2018.
2.	Hayes John P, "Computer Architecture and Organization", 3 <sup>rd</sup> Edition, McGraw-Hill, New Delhi, 2017.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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	understand various types I/O devices and memory organization	Understanding (K2)
CO5	Infer serial communication methods and networking standards	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	3	3	3										3
CO3	3	3	3	3								1		3
CO4	3	2	2									2		
CO5	3	2										2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30				100
CAT2	15	50	35				100
CAT3	20	80					100
ESE	20	50	30				100



Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Physics for Communication and Computer Science Engineering	5	PE	3	0	0	3

Preamble	To learn different types of display devices, detection mechanism and optoelectronic integrated circuits with applications	
Unit - I	Elements of Light, Solid State Physics:	9
Wave nature of light- Polarization interference- Diffraction- Light Source- Review of quantum mechanical concept- Review of solid state physics- Review of semiconductor physics and semiconductor junction device		
Unit - II	Display Devices and Lasers:	9
Photo luminescence- Cathode luminescence- Electro luminescence- Injection luminescence- LEDS plasma display- Introduction to OLED- Liquid crystal displays- Numeric displays laser emission- Absorption- Radiation- Population inversion optical feedback- Threshold condition-Line shape function-Pumping - Laser modes- Classes of lasers- Mode locking- Q switching- Laser applications-Measurements of distance –Holography -Laser induced nuclear fusion		
Unit - III	Optical Detectors:	9
Photo detector- Thermal detector- Photo devices- Photo emissive devices-Photomultiplier- Noise in Photomultiplier- Photon counting technique- Image intensifier - Photo conductive detectors- Noise in photoconductive detectors - Junction detectors- Detector array - Detector performance		
Unit - IV	Optoelectronic Modulator:	9
Introduction- Analog and digital modulation Franz-Keldysh and Stark effect modulators: Quantum well - Electro absorption modulators- Electro optic modulators- Magneto optic devices- Acousto optic devices- Optical switching and logic devices.		
Unit - V	Integrated Circuits:	9
Introduction to optoelectronic ICs- Hybrid and monolithic integration- Application of optoelectronic integrated circuits- Integrated transmitters and receivers- Guided wave devices		

**Total:45****TEXT BOOK:**

1. Wilson J & Hawkes J, "Opto-electronics: An Introduction", 3<sup>rd</sup> Edition, PHI Learning, New Delhi, 2007.

**REFERENCES:**

1. Pallab Bhattacharya, "Semiconductor Opto-electronic Devices", 2<sup>nd</sup> Edition, PHI Learning, New Delhi, 2006.
2. Emmanuel Rosencher and Berge Vinter, "Optoelectronics", 1<sup>st</sup> Edition, Cambridge University Press, New York, 2002.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	interpret the state-of-art optoelectronic technology	Understanding (K2)
CO2	apply quantum mechanics and its role in the design and operation of optoelectronic devices	Applying (K3)
CO3	perceive semiconductor material properties and semiconductor optoelectronic device physics	Understanding (K2)
CO4	apply analog and digital modulation techniques for optical modulators, Magnetic and Switching applications	Applying (K3)
CO5	apply the concepts of Integrated circuit theory for the design of optoelectronics systems	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1								2	1	1
CO2	2	3	1									2	1	1
CO3	2	3	1				1	1				2		
CO4	2	3	1						1	1		2		
CO5	2	2	3									2	1	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	45	35				100
CAT2	10	35	55				100
CAT3	10	35	55				100
ESE	10	40	50				100

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

**20ECE06 - SOFT COMPUTATIONAL TECHNIQUES**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>5</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To learn and understand Neural Network algorithms and Fuzzy inference systems for solving real time problems	
Unit - I	Introduction To Neural Networks:	9
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:	9
Supervised Learning Networks: Perceptron Network : Theory – Architecture- Learning Rule, Back Propagation Network : Theory – Architecture- Training and Testing Algorithm - Adaptive linear neuron - Radial Basis Function Network (RBFN) - Associative memory networks: Discrete hop field network - Kohonen self organising feature maps.		
Unit - III	Advanced Neural Network:	9
Support Vector Machine Classifier – Decision tree classifier-Random Forest Classifier – Extreme Learning Machine ( Training and testing algorithms only)		
Unit - IV	Basic Concepts of Fuzzy Logic:	9
Introduction to fuzzy logic - Classical sets and fuzzy sets - Fuzzy relations - Membership function: Features of membership function – Fuzzification - Methods of membership value assignments - Fuzzy rules and reasoning: Fuzzy If-Then Rules		
Unit - V	Fuzzy Inference Systems (FIS):	9
Introduction – Methods of FIS: Mamdani - Sugeno and Tsukamoto. Defuzzification: Lambda-Cuts for Fuzzy sets and Fuzzy Relations, Defuzzification Methods Applications of Neural networks and Fuzzy logic: In image processing-forecasting –communication-business		

**Total:45****TEXT BOOK:**

1.	S.Rajasekharan & G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Systems and Evolutionary algorithms: synthesis and applications", 2 <sup>nd</sup> Edition, Prentice Hall of India, New Delhi, 2018.
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**REFERENCES:**

1.	Timothy J.Ross, "Fuzzy Logic with Engineering Applications", 3 <sup>rd</sup> Edition, John Wiley, New Delhi, 2010.
2.	Sivanandam S.N, Sumathi S & Deepa S.N, "Introduction to Neural Networks using MATLAB 6.0", 1 <sup>st</sup> Edition, Tata McGraw-Hill, New Delhi, 2006.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	interpret the concepts of neural network	Understanding (K2)
CO2	develop neural network architecture using supervised and unsupervised learning	Applying (K3)
CO3	interpret the concepts of SVM, ELM and random forest classifiers	Understanding (K2)
CO4	develop fuzzy sets and rules for real time applications	Applying (K3)
CO5	apply FIS models and neural network for real time applications	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	3	2	2	3									
CO3	3	2	2	2	3									2
CO4	3	2	1	1	3				2				2	2
CO5	3	2	2	2	3	2		2	2	2		2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	25	45	30				100
CAT3	10	30	60				100
ESE	20	30	50				100

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



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECE07 - LINUX OPERATING SYSTEMS**

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	Linux Introduction	6
Linux History , Distribution, Installing of Linux, First step on command line - man pages, Working with directories, files, file contents, Linux file tree		
Unit - II	Shell Expansion	6
Commands and arguments, Control operators, Shell Variable, Shell embedding, file globbling.		
Unit - III	Pipes and Commands	6
I/O redirection, filters, basic Unix tool, Regular expression.		
Unit - IV	VI Editor and Scripting	6
Introduction to vi, Scripting: Introduction, loops, parameters, more scripting.		
Unit - V	Case Studies	6
Scripting for auto startup applications – application package installation - Linux in single board computer – simple Linux application development.		

**List of Exercises / Experiments:**

1.	Display the architecture of Linux running and flash .iso into USB pen drive attached and verifies both are same.
2.	List all "current shell variables", files in "/bin" directory and create new directory in the Desktop from the home directory.
3.	Create a file that contains the history of commands used in the file named as my_his.txt and also display the date in YYYY/MM/DD format
4.	Find and replace the pattern of string in the File using VI editor
5.	Create a file and write some message and save it.
6.	Write the script that have to shut down your system properly at 04:30PM daily
7.	Write the script to auto startup of some specific application when the system is booted.

**Lecture: 30, Tutorial:30, Total: 60**

**TEXT BOOK:**

1.	Paul Cobbaut ,“Linux Fundamentals” , GNU Free Documentation License 2015
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**REFERENCES/MANUALS/SOFTWARES:**

1.	<a href="https://www.linux.org/docs">https://www.linux.org/docs</a>
2.	<a href="https://www.raspberrypi.com/documentation/computers/using_linux.html">https://www.raspberrypi.com/documentation/computers/using_linux.html</a>
3.	Laboratory Manual



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	realize different Linux distributions and Linux file tree	Understanding(K2)
CO2	use Linux commands and apply shell operators	Applying(K3)
CO3	realize pipe commands and regular expressions	Applying(K3)
CO4	comprehend editor and apply shell scripting knowledge for automation	Applying(K3)
CO5	separate pattern matching from files	Understanding(K2)
CO6	reveal the execution of Linux commands	Applying(K3), Precision(S3)
CO7	demonstrate the execution in usage of regular expression using vi editor	Applying(K3), Precision(S3)
CO8	expose the execution of application in auto startup mode	Applying(K3), Precision(S3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		1				2			2	1	
CO2	3	2	1		2				2			2	2	
CO3	2	2	1		3				2			2	2	
CO4	2	3	2		3				3			2	2	
CO5	2	2	1		2				1			1	2	
CO6	2	3	3	2	2				2	2	2	2	2	
CO7	2	3	3	2	3				2	2	2	2	2	
CO8	2	3	3	2	3			2	3	2	2	2	2	2

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	60	10				100
CAT2	15	60	25				100
CAT3	15	55	30				100
ESE	15	60	25				100

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





Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Analog & Digital communication	7	PE	3	0	0	3

Preamble	To acquire the fundamental concepts in cellular communication technology and articulate the study of 4th generation and 5th generation 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 – Knife edge diffraction model - Scattering 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	4G 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		

**Total:45****TEXT BOOK:**

1. Rappaport S. Theodore, "Wireless Communications", 2<sup>nd</sup> Edition, Pearson Education, 2010.

**REFERENCES:**

1.	Christopher Cox, "An Introduction to LTE: LTE, LTE Advanced, SAE, VoLTE and 4G Mobile Communications", 2 <sup>nd</sup> Edition, Wiley Publications, New Delhi, 2014.
2.	Saad Z. Asif, " 5G Mobile Communications Concepts and Technologies", 1 <sup>st</sup> Edition, CRC Press Taylor & Francis Group, USA, 2019.

<b>COURSE OUTCOMES:</b>	<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to	
CO1 understand the cellular concept and its coverage with capacity improvement	Understanding (K2)



	techniques.	
CO2	characterize the propagation models and channel models	Applying (K3)
CO3	illustrate 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	interpret the characteristics of 4G wireless 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	1	2											
CO2	3	2	1	1	1								1	
CO3	2	1	3		2								1	
CO4	3	1											1	
CO5	3											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	30	40	30				100
CAT2	15	30	55				100
CAT3	30	70					100
ESE	30	50	20				100

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

### 20ECE09 - EMBEDDED SYSTEMS DESIGN

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	Microprocessor and Microcontroller	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>



<b>Preamble</b>	To understand the concept of embedded system life cycle including partitioning, toolset, emulators and testing.	
<b>Unit - I</b>	<b>Embedded Design Life Cycle:</b>	<b>9</b>
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.		
<b>Unit - II</b>	<b>Partitioning Decision:</b>	<b>9</b>
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.		
<b>Unit - III</b>	<b>Embedded Toolset:</b>	<b>9</b>
Interrupt service routines – Watch dog timers – Flash memory - Basic toolset – Host Based debugging – Remote debugging – ROM emulators – Logic analyzer – Caches – BDM – JTAG		
<b>Unit - IV</b>	<b>In circuit Emulators:</b>	<b>9</b>
Bullet proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers		
<b>Unit - V</b>	<b>Testing:</b>	<b>9</b>
Bug tracking – Reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance		

**Total:45****TEXT BOOK:**

- |    |   |
|----|---|
| 1. | Arnold S.Berger, “Embedded Systems Design: An Introduction to Processes, Tools, and Techniques Hardcover”, 1 <sup>st</sup> Edition,CRC press,USA, 2017. |
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**REFERENCES:**

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|----|---|
| 1. | Sri ram Iyer, “Embedded Realtime System Programming” , 1 <sup>st</sup> Edition, McGraw-Hill, 2008.      |
| 2. | David E.Simon, “An Embedded Software Primer” ,12 <sup>th</sup> Indian Reprint, Pearson Education, 2005. |



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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	Understanding (K2)
CO5	understand the different types of testing in embedded system	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3	2												
CO3	3	2	3	2	3									
CO4	3	2		3										
CO5	3	2		2								3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	50	30				100
CAT3	20	80					100
ESE	15	60	25				100

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



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 principles of various instruments and transducers in industrial use and learn Virtual Instrumentation and its importance in design of systems.	
Unit - I	Measurement Concepts and Measuring Instruments:	9
Measurement systems- Static and dynamic characteristics – Units and standards of measurements – Error analysis – Moving coil – Torque equations - DC Ammeters-DC Voltmeters-Digital meters: Wattmeter-Energy meters – Bridge measurements: Maxwell- Kelvin- Schering.		
Unit - II	Transducers:	9
Strain gauge- Thermistor - Humidity sensor- Variable reluctance transducers – Linear variable differential transformer- Capacitive transducer – Piezoelectric transducers – Vibration sensor– Proximity sensor- Optoelectronic transducers- Implementation of Instrumentation amplifier with sensor.		
Unit - III	Virtual Instrumentation & Software:	9
Block diagram of a virtual instrument – Physical quantities and analog interfaces - Hardware and software – User interfaces – Advantages– Architecture of a virtual instrument and its relation to the operating system - LabVIEW – Graphical user interfaces - Controls and indicators.		
Unit - IV	VI Software Tools & Programming Techniques:	9
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 – String and file I/O – High level and Low level file I/Os – Attribute nodes- Local and global variables.		
Unit - V	PLC Programming:	9
PLC: Evolution – Components of PLC – Advantages over relay logic – PLC programming languages – Ladder diagram – Programming timers and counters –PLC specifications – Timer functions: Types, Programming - Counter functions: Types, Programming		

**Total:45****TEXT BOOK:**

1.	Helfrick Albert D. and Cooper William D, "Modern Electronic Instrumentation and Measurement Techniques", 2 <sup>nd</sup> Edition, PHI Learning, New Delhi, 2003, I,II
2.	Jeffery Travis and Jim Kring, "LabVIEW for Everyone: Graphical programming made easy and Fun, 3 <sup>rd</sup> Edition, Pearson Education, India, 2009.

**REFERENCES:**

1.	Webb John W. and Reis Ronald A., "Programmable Logic Controllers", 5 <sup>th</sup> Edition, PHI Learning, New Delhi, 2005.
2.	Jovitha Jerome, "Virtual Instrumentation using LabVIEW" , 1 <sup>st</sup> Edition, PHI Learning, New Delhi, 2010.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	use different measuring instruments and sensors	Applying (K3)
CO2	understand the working principle of various transducers for real time applications	Understanding (K2)
CO3	develop programs for virtual systems using LabVIEW	Applying (K3)
CO4	design virtual system using the features of LabVIEW	Applying (K3)
CO5	build ladder diagram for industrial applications	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		1	2		1				1	2	
CO2	2	1				1						2	3	1
CO3	3	2	1		3	2		1	2	2		2	3	2
CO4	3	2	1		3	2		1	2	2		2	3	2
CO5	3	2	1		3	2		1	2	2	2	2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



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 the different types of Printed Circuit Boards, design concepts, 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, Terminologies in PCB Designing, Types of PCBs: Single Sided (Single Layer), Double Layer and Multi-Layer PCB, Flexible PCB, Materials for PCB manufacturing.		
Unit - II	PCB Design Considerations:	6
PCB Design flow, 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, Token Counter, Wien-bridge Oscillator.		

**List of Exercises / Experiments:**

1.	Study of CAD for PCB Design (Eagle CAD or Equivalent Open Source Tool)
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.	Trouble shooting of single layer and multi-layer PCB

**Lecture:30, Practical:30, Total:60****TEXT BOOK:**

1.	Khandpur R S, "Printed Circuit Board: Design, Fabrication, Assembly and Testing", 1 <sup>st</sup> Edition, McGraw Hill Education Pvt.Ltd., New Delhi, 2017.
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**REFERENCES/Manuals/Softwares:**

1.	Mehta S D, "Electronic Product Design: Volume 1 –Basics of PCB Design", 1 <sup>st</sup> Edition, S Chand Publications, New Delhi, 2011.
2.	Clyde Coombs, " Printed Circuits Handbook", 7 <sup>th</sup> Edition, McGraw Hill Professional, New Delhi, 2016.
3.	Laboratory Manual.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	summarize different types of PCBs	Understanding (K2)
CO2	describe the PCB design rules and considerations	Understanding (K2)
CO3	apply the PCB Design rules to design and simulate single layer PCB	Applying (K3)
CO4	prepare Gerber file for a single layer PCB for a given circuit	Applying (K3)
CO5	realize the steps to examine and trace the assembled electronic components on PCB	Understand (K2)
CO6	construct and verify the working of a single layer PCB using simulation software	Applying (K3), Precision (S3)
CO7	carry out steps to fabricate single layer PCB	Applying (K3), Precision (S3)
CO8	identify the fault of a given PCB and suggest solutions to rectify the fault	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
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	2	2		3							2	3	1
CO4	3	2	2		3							2	3	1
CO5	3	3	2		3							2	3	2
CO6	3	3	3		3				2	2		2	3	2
CO7	3	2	3		3				2	2		2	3	2
CO8	3	2	3		3				2	2		2	3	2

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	20	45	35				100
CAT3	10	35	55				100
ESE	20	45	35				100

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



**20ECE12 - DIGITAL IMAGE PROCESSING**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Digital Signal Processing</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To apply the various Digital Image Processing techniques to process the real time images	
Unit - I	Digital Image Fundamentals:	9
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 and its Properties: Separable – Spatial shift – Periodicity –Scaling – Orthogonality – Rotation, DCT, Haar		
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. Image Restoration: Degradation model – Noise distributions– Median – Geometric mean – Harmonic mean – Contrast harmonic mean filters – Order Statistics filters – Inverse and Wiener filtering – Constrained least square filtering.		
Unit - III	Image Segmentation, Representation and Description:	9
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 - IV	Image Compression:	9
Fundamentals: Fidelity Criteria – Image Compression Model – Types of redundancy – Huffman – Run length coding – Arithmetic coding – Bit-plane coding – Block Transform coding – Lossless and Lossy Predictive coding – JPEG standard		
Unit - V	Object Recognition and Application:	9
Patterns and Pattern Class – Recognition based on Decision-Theoretic Methods – Matching – Structural Methods Applications: Local Naive Bayes and Nearest Neighbor for Image Classification		
Total:45		

**TEXT BOOK:**

1.	Rafael C Gonzalez & Richard E Woods, "Digital Image Processing", 4 <sup>th</sup> Edition, Pearson Education, New Delhi, 2018.
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**REFERENCES:**

1.	Jayaraman S, Esakkirajan S & Veerakumar T, "Digital Image Processing", 1 <sup>st</sup> Edition, 22 <sup>nd</sup> Reprint, Tata McGraw Hill, New Delhi, 2018.
2.	Anil K Jain, "Fundamentals of Digital Image Processing", 4 <sup>th</sup> Edition, PHI Learning, New Delhi, 1995.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	demonstrate the fundamental concepts and image transforms	Applying (K3)
CO2	apply Image enhancement and restoration techniques in both spatial and frequency domain to improve the quality of images	Applying (K3)
CO3	identify the features and region of interest of an image using segmentation, representation and description techniques for image classification	Applying (K3)
CO4	employ image compression algorithms on digital images	Applying (K3)
CO5	apply image recognition techniques for real time applications	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									1	
CO2	3	2	2	2								2	1	
CO3	3	2	2	2		2				2		2	1	2
CO4	3	2	2	2								2	1	2
CO5	3	2	2	2	3	2		2	2	2		2	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	20	60				100
CAT3	10	50	40				100
ESE	15	45	40				100

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



<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>VLSI Design</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To learn different programmable ASICs, logic cells, I/O cells and interconnects and to perform synthesis and physical design flow in ASIC design	
Unit - I	Introduction to ASICs, CMOS Logic, ASIC Library Design, Programmable ASICs:	9
Types of ASICs - Design flow – CMOS transistors- Transistor as resistors - Transistor parasitic capacitance – Logical effort-Antifuse - Static RAM - EPROM and EEPROM technology		
Unit - II	Programmable ASICs, logic cells and I/O Cells:	9
Actel ACT - Xilinx LCA - DC & AC inputs and outputs – Clock & power inputs		
Unit - III	Programmable Interconnects and Logic Synthesis:	9
Actel ACT – Xilinx LCA - Verilog logic synthesis: Delays, Blocking and Non blocking assignment, Combinational logic, multiplexers, Case statement, decoders, arithmetic and Sequential logic		
Unit - IV	Partitioning, Floorplanning and Placement:	9
Physical design flow -System partitioning - FPGA partitioning:KL algorithm –Floorplanning –Placement : Constructive and iterative placement algorithms		
Unit - V	Routing:	9
Global routing - Detailed routing –Area routing-Maze Algorithm-Channel routing- Left Edge Algorithm-Special routing		
Total:45		

**TEXT BOOK:**

1. Smith M.J.S, "Application Specific Integrated Circuits", 12<sup>th</sup> Edition, Pearson Education Pvt. Ltd, New Delhi, 2013.

**REFERENCES:**

1. Wayne Wolf, "FPGA-Based System Design", 1<sup>st</sup> Edition, PHI, New Delhi, 2009.
2. Erik Larson, "Introduction to Advanced System-on-Chip Test Design and Optimization", 1<sup>st</sup> Edition, Springer, USA, 2005.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	infer the different types of ASICs design, CMOS characteristics and programming technologies & programmable ASICs	Understanding (K2)
CO2	elucidate the different programmable ASIC logic cells and I/O cells	Understanding (K2)
CO3	infer the different programmable interconnects and synthesis	Understanding (K2)
CO4	apply algorithms for partitioning, floor planning and placement	Applying (K3)
CO5	perform routing design in an ASIC	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1						2				1		3
CO2	2	1	1					2				2	1	3
CO3	2	1				1		2				1		3
CO4	3	2	1	1		2	2	3				2	1	3
CO5	3	2	1	1		2		3				2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	80					100
CAT2	20	80					100
CAT3	10	20	70				100
ESE	10	40	50				100

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



<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Data communication and Networking</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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 logarithms. Classical Encryption techniques: Symmetric cipher model, substitution techniques, transposition techniques, Stream and block cipher techniques.		
Unit - III	Symmetric Key Cryptography and Public Key Cryptography:	9
Data Encryption Standard-Block cipher principles-block cipher modes of operation, Advanced Encryption Standard (AES). Public key cryptography: Principles of public key cryptosystems-The RSA algorithm- Security of RSA.		
Unit - IV	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.		
Unit - V	IP Security:	9
Overview of IPSec - IP security policy, encapsulating security payload, combining security association, Internet key exchange, Cryptography suites.		

**Total: 45****TEXT BOOK:**

1.	William Stallings, "Cryptography and Network Security", 7 <sup>th</sup> Edition, Pearson Education Pvt. Ltd., New Delhi, 2017.
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**REFERENCES:**

1.	Behrouz A. Ferouzan & Debdeep Mukhopadhyay, "Cryptography and Network Security", 3 <sup>rd</sup> Edition, Tata McGraw-Hill, New Delhi, 2015
2.	Charles P. Fleeger, "Security in Computing", 5 <sup>th</sup> Edition, Prentice Hall, New Delhi, 2015.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understand OSI security architecture and mathematics of cryptography	Understanding (K2)
CO2	understand number theory and classical encryption techniques	Applying (K3)
CO3	apply knowledge in symmetric and public key cryptography	Applying (K3)
CO4	infer different wireless and email security mechanism	Analyze (K4)
CO5	analyze attacks in IP networks	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	40	30	10			100
CAT3	20	60	20				100
ESE	20	30	40	10			100

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



Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mobile Communication, 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 HiperACCESS.		
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.
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**REFERENCES:**

1	Jeffrey G. Andrews, Arunabha Ghosh and RiasMuhammed, "Fundamentals of WiMAX: understanding broadband wireless networking", Pearson Education, 2007.
2.	Kwang-Cheng Chen and J. Roberto B. de Marca, "Mobile WiMAX", John Wiley & Sons, 2008.
3.	Uma ShankerJha and Ramjee Prasad, "OFDM Towards Fixed and Mobile Broadband Wireless Access", Artech House, 2007.

<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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	25	50	25				100
ESE	20	60	20				100

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

#### 20ECE16 - EMBEDDED IOT

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
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<b>Prerequisites</b>	<b>Microprocessor and Microcontroller</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
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Preamble	To understand and apply the basic concept of IoT Systems for real time applications	
Unit - I	Introduction to M2M and IoT:	9
Introduction–M2M communication–IoT (Internet of Things)–Implications for IoT–IoT value chains– Real-World Design Constraints–An emerging industrial structure for IoT–M2M and IoT analytics: Introduction–Analytics architecture.		
Unit - II	IoT Architecture and Use Case:	9
IoT Reference Model: IoT domain model– Information model–Functional model–communication model–Safety, Privacy, Trust, Security model Implementation Examples: The Smart Grid–Industrial Automation.		
Unit - III	Introduction to Raspberry pi and Python Programming:	9
Raspberry Pi: History of the Raspberry Pi - Installing the Raspbian OS and Overview of OS -Python Programming: Python tools for Raspberry Pi -Using the Python command line - Writing a simple Python program - Creating the class - Creating the object - Using the object inspector - Testing your class - Making the code flexible - Reading the state of a button		
Unit - IV	Web Services and Raspberry Pi as Web Server:	9
Subscribing to Web Services: Amazon Web Services IoT - IBM Watson platform - Google Cloud platform - Microsoft Azure - Weather Underground - A basic Python program to pull data from the cloud. Raspberry Pi as Web Server: Introducing CherryPy - a minimalist Python web framework - Creating a simple web page using CherryPy		
Unit - V	Case studies:	9
Reading the state from an infrared motion sensor - Modifying Hello LED using infrared sensor. IoT Projects Preparation: Using the DHT11 to find temperature and humidity- Using the Pi camera to take a photo - Creating and Displaying data on dashboard using CherryPy.		

**Total:45****TEXT BOOK:**

1.	Jan Holler, "From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence", 1 <sup>st</sup> Edition, Academic Press - Elsevier, Waltham, USA, 2014 for units I and II
2.	Colin Dow, "Internet of things Programming Projects", 1 <sup>st</sup> Edition, PACKT publishing, Birmingham, UK, 2018 for units III,IV and V.

**REFERENCES:**

1.	<a href="https://www.raspberrypi.org/documentation">https://www.raspberrypi.org/documentation</a>
2.	<a href="https://docs.python.org/3/">https://docs.python.org/3/</a>



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	describe the basic concepts of M2M and IoT	Understanding (K2)
CO2	distinguish different IoT Architectures for automation	Understanding (K2)
CO3	apply python programming knowledge for IoT application developments	Applying (K3)
CO4	manipulate software and hardware of single board computer for web interface	Applying (K3)
CO5	develop IoT based projects for real time applications using single board computer	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1									2	1
CO3	3	2	1	1	3				2	2	1	1	2	1
CO4	3	2	1	1	3				2	2	2	2	3	2
CO5	3	2	1	1	3				3	3	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	30	60				100
ESE	10	60	30				100

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

**20ECE17 - DSP PROCESSOR AND ITS APPLICATIONS**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Signal Processing	7	PE	3	0	0	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:	9
Interface- DSP Hardware-DSP system Design- Multiplier and Multiplier accumulator (MAC) – Modified Bus Structures and Memory access in Programmable DSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals		
Unit - II	Introduction to TMS320C67xx Digital Signal Processor:	9
Fundamentals of Programmable DSPs - Architecture of TMS320C67XX - Buses- Computational Units- -On-chip peripherals-Timers and Interrupts		
Unit - III	TMS320C67xx Programming:	9
Pipeline operation - Address Generation Units-Memory organization- Memory architecture -Addressing modes and instruction set-assembly language instructions		
Unit - IV	DSP Interfacing	9
Interfacing with serial I/O, A/D,D/A converters, parallel interfacing, interfacing with RAM,EEPROMS, DSP Tools : Assembler, Debugger, C compiler, Linker and Loader, Programming Examples Using C Code with CCS		
Unit - V	Applications Using TMS320C67XX:	9
FIR Filter applications-Adaptive filter Applications-Image Processing Applications- ( all applications using Simulink Blocksets)		

**Total:45****TEXT BOOK:**

1.	Venkataramani B. and Bhaskar M., "Digital Signal Processors: Architecture, Programming and Applications", 2 <sup>nd</sup> Edition, McGraw Hill, New Delhi, 2011
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**REFERENCES:**

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 <sup>nd</sup> Edition, John Wiley & Sons Ltd.,2006



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	infer the basic concepts of real time DSP processor	Understanding (K2)
CO2	summarize the architectural concepts of C67xx processor	Understanding (K2)
CO3	apply programming concepts to develop simple and real time applications using C67xx processor	Applying (K3)
CO4	understand the peripheral interfacing with DSP processor	Understanding (K2)
CO5	implement the filtering operations on signals and images using DSP processors	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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	2		2	2			2	2		2	3	
CO4	2	1				2	2					2	3	
CO5	3	2	2		2	1			2	2	2	2	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	60	20				100
ESE	25	55	20				100

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



<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Linear Algebra and Transforms</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To learn and apply the various Wavelet Transform techniques on real time signals and images.	
Unit - I	Wavelet Fundamentals:	9
Vector spaces – Relationship between functions, Sequences, Vectors – Properties – Fourier transform and non-stationary signals – Limitations – Review of sampling theorem.		
Unit - II	Haar Wavelet:	9
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. Daubechies Family: Calculation of scaling function – Daub-4 and Daub-6 design details.		
Unit - III	Continuous Wavelet Transform:	9
The uncertainty principle – Time-bandwidth product – Time-Frequency tiling – STFT and wavelets – CWT- Comparison of STFT and CWT – Interpretation of spectrogram plot – Reconstruction and Admissibility – Discreitization of scale.		
Unit - IV	Discrete Wavelet Transform:	9
Dyadic MRA – Theorem – Inverse DWT computation – Bi-orthogonal and orthogonal filter banks – Construction of Orthogonal filterbank – Variants of MRA: Splines and Wavelet packets. Other Wavelet Families: Mortlet, Mexican Hat, and Gabor – Multi-dimensional wavelets: 2-D Haar wavelet transform.		
Unit - V	Applications:	9
Compression – Denoising – Analysis of biomedical signals and images using wavelets		

**Total:45****TEXT BOOK:**

1.	Soman K.P. and Ramachandran K.I., "Insight into Wavelets - From Theory to Practice", Prentice Hall of India, 2013.
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**REFERENCES:**

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", 3 <sup>rd</sup> Edition, Academic Press, 2009.
3.	Vikram M Gadre and Aditya S Abhyankar, "Multiresolution and Multirate Signal Processing", McGraw Hill Education, 1 <sup>st</sup> Edition, 2017.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	illustrate the fundamentals of vectors spaces and properties	Understanding(K2)
CO2	apply haar wavelet and daubechies wavelet on discrete samples	Applying (K3)
CO3	utilize continuous wavelet transform for the interpretation of spectrum plots and its reconstruction	Applying (K3)
CO4	experiment with discrete wavelet transform of orthogonal filter banks	Applying (K3)
CO5	demonstrate the application of different wavelets on biomedical signals and images	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						
CO2	3	2	2	2				3					2	
CO3	3	2	2	2				2					2	
CO4	3	2	2	2				2					2	
CO5	2	1				2		2		2			3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	30	50				100
CAT3	20	50	30				100
ESE	20	40	40				100

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



<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>VLSI Design</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To understand the process of test generation, 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 of Combinational Circuits:	9
Algorithms and representation- Redundancy identification- Testing as a global problem-Combinational ATPG algorithm-D-algorithm-PODEM-FAN-Test generation Systems-Test compaction.		
Unit - III	Test Generation of Sequential Circuits:	9
ATPG for single clock synchronous circuits- Time-Frame expansion method-Simulation based sequential circuit		
Unit - IV	Design for Testability:	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 behavior		

**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, 2 <sup>nd</sup> Printing, 2005. |
|----|---|

**REFERENCES:**

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|----|---|
| 1. | Abramovici, M., Breuer, M.A and Friedman, A.D., "Digital Systems and Testable Design", Jaico Publishing House, 13 <sup>th</sup> Impression, 2012.                               |
| 2. | Laung – Terng wang, Cheng – wen wu, Xidogingwen, "VLSI Testing Principles and Architectures: Design for Testability", Morgan Kaufmann Publisher, 2 <sup>nd</sup> Reprint, 2013. |



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	interpret the different types of fault models	Understanding (K2)
CO2	generate test patterns to detect the fault in combinational circuits	Applying (K3)
CO3	generate test patterns to detect the fault in sequential circuits	Applying (K3)
CO4	design a circuit for testability	Applying (K3)
CO5	infer the different measures of system diagnosability	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1										2		2
CO2	3	2										2	2	2
CO3	3	2										2	2	2
CO4	3	2	1		2			2				2	2	2
CO5	2	1										2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	60	30				100
ESE	10	60	30				100

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





<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To learn intelligent algorithms which can perform/mimic the task of human visual perception.	
Unit - I	Image Formation and Transformations:	9
Image Formation – Sampling and Representation - Types of Images: Binary, Gray and Colour - Neighbourhood Processing – Transformations: Shifting, Rotations and Scaling – Image filtering in time-domain.		
Unit - II	Feature Detection:	9
Properties: Scale and Rotation Invariance – Affine Invariance – DoG Descriptors – Feature Descriptors: Haris Corner - ANMS – SIFT, Feature Matching Strategy and error rates.		
Unit - III	Segmentation:	9
Active Contours: Snakes – Dynamic Snakes – Level Sets, Area: Watershed – Graph Cuts- K-means Clustering		
Unit - IV	Object Classification:	9
Linear classification – Curse of Dimensionality - Support vector machine – Loss functions – Optimization – Non-linearly separable cases – Regularization		
Unit - V	Case Study:	9
Face Recognition: Eigen faces – Artificial Neural Networks – Activation functions – Back Propagation – Convolutional Neural Networks – Architectures		

**Total:45****TEXT BOOK:**

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2<sup>nd</sup> Edition, Springer, NewYork, 2011.

**REFERENCES:**

1. M Mohri, A Rostamizadeh & A Talwalkar, "Foundations of Machine Learning", 2<sup>nd</sup> Edition, MIT Press, USA, 2018.
2. Stanford Lecture Notes at <https://cs231n.github.io/convolutional-networks/>



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply the various spatial transformations on the image	Applying (K3)
CO2	extract various feature detector and matching techniques	Applying (K3)
CO3	make use of various established segmentation algorithms for a specific task	Applying (K3)
CO4	apply linear classification algorithms for image classification and recognition	Applying (K3)
CO5	use artificial neural networks and deep convolutional neural networks for face recognition	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2				2			2	3	2
CO2	3	2	1	1	2							2	3	2
CO3	3	2	1	1	3							2	3	2
CO4	3	2	1	1	3				2			2	3	2
CO5	3	2	1	1	3				2			2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	VLSI Design	7	PE	3	0	0	3

Preamble	This course equips the students to understand the concepts of standard MEMS and apply the knowledge of micro fabrication techniques for the design and manufacturing of a MEMS device or a micro system.	
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 and Manufacture”, 2 <sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2008.
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**REFERENCES:**

1.	Mohamed Gad-el-Hak, “The MEMS Hand book”, 2 <sup>nd</sup> Edition, CRC press, 2006
2.	M.-H. Bao, “Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes”, 1 <sup>st</sup> Edition, Elsevier, New York, 2004



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	acquire knowledge of MEMS concepts and Scaling laws	Understanding(K2)
CO2	understand the principles of Micro Sensors and Actuators	Applying(K3)
CO3	gain knowledge about mechanics	Understanding(K2)
CO4	know the micro fabrication and micro manufacturing techniques	Applying(K3)
CO5	apply the knowledge to design a micro system.	Applying(K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3		2						2	3	
CO2	3	3	3	3	3	3		3				3	3	3
CO3	3	2		3										
CO4	3	3	3	3	3			3				3	3	
CO5	3		3	3	3			3				3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	20	20	60				100
ESE	20	30	50				100

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



**20GEE01 - FUNDAMENTALS OF RESEARCH**  
(Common to all BE/BTech branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3
Preamble	This course familiarize 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 - Outcome 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 - Measurement 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
Reports and Presentations: 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". Routledge, 2017.

**REFERENCES:**

1. Melville S, Goddard W. "Research Methodology: An Introduction For Science and Engineering Students". Kenwyn: Juta & Co Ltd., 1996.
2. Kumar, Ranjit. "Research Methodology: A step-by-step guide for beginners". SAGE Publications Limited, 2019.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	list the various stages in research and categorize the quality of journals.	Analyzing (K4)
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)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	3	2	2	1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1		3	3	3	2	2	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														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1		40	35	25			100
CAT2		30	40	30			100
CAT3				50	50		100
ESE		25	25	25	25		100

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

**20ECE22 - 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 sub satellite 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
<b>Earth Segment</b> : Introduction – Receive only home TV systems – Outdoor unit -Indoor unit for analog (FM) TV – MATV system –CATV system – Transmit receive earth stations <b>Space Link:</b> 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	Applications :	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****TEXT BOOK:**

1.	Roddy Dennis, "Satellite Communications", 4 <sup>th</sup> Edition, Mc-Graw Hill, New York, 2017.
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**REFERENCES:**

1.	Varsha Agrawal and Anil K.Maini, "Satellite Communications", 1 <sup>st</sup> Edition, Wiley India Pvt. Ltd., New Delhi, 2010.
2.	Pratt Timothy, Bostian Charles and Allnutt Jeremy, "Satellite Communications", 2 <sup>nd</sup> Edition, Wiley India Private Limited, New Delhi, 2006.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	recite the various terminologies in satellite communication problems	Remembering (K1)
CO2	recognize the working of various sub systems of a satellite	Understanding (K2)
CO3	make use of terminal stations to broadcast the programmes through satellite earth stations and understand the effect of losses	Applying (K3)
CO4	comprehend different access methodologies of satellite communication	Applying (K3)
CO5	illustrate the different types of satellite based on 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	
CO2	3	2	2	2								2	2	
CO3	3	2		2								2	2	
CO4	3	2		2				2				2	2	
CO5	3	2	2	2				2				2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	20	55	25				100
CAT3	15	60	25				100
ESE	20	55	25				100

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





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 onvarious 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 IEEE 802.11 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 802.11 MAC Protocol, MAC Enhancements for QoS Support, Performance understanding of IEEE 802.11e EDCA, IEEE 802.11n 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	IEEE 80211.ac (MAC):	9
Framing, medium access procedures, Beamforming Basics, Single-User (SU) Beamforming, Multi-User (MU) Beamforming, Building an 802.11ac Network.		

**Total:45**

**TEXT BOOK:**

1.	Benny Bing, "Emerging Technologies in Wireless LANs Theory, Design, and Deployment", 1 <sup>st</sup> Edition, Cambridge University Press, 2008 for units I,II &III
2.	Matthew S. Gast "802.11ac: A Survival Guide", 1 <sup>st</sup> Edition, O'Reilly, 2013 for units IV &V.

**REFERENCES:**

1.	Gary. S. Rogers and John Edwards, "An Introduction to Wireless Technology", 2 <sup>nd</sup> Edition, Pearson Education, 2007.
2.	Clint Smith P.E. and Daniel Collins, "3G Wireless Networks", 2 <sup>nd</sup> Edition, McGraw Hill, 2007.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	perceive various wireless standards and technologies	Remembering(K1)
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	analyse different concepts in IEEE 80211.ac MAC layer	Analysing (K4)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1					3					1		1	
CO2	3	2	1			2						1	3	2
CO3	3	2	1	1		2							3	2
CO4	3	2	1			2							3	2
CO5	3	3	2	2	1	2					1		3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	20	60	20				100
CAT3	10	45	25	20			100
ESE	10	50	25	15			100

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



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECE24 - 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 systems for embedded applications development	
Unit - I	Introduction to RTOS:	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 – 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:	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. Case study: Design of Embedded Systems using µC/OS-II: Automatic Chocolate Vending Machine and Digital Camera		
Total:45		

**TEXT BOOK:**

1.	Jean J. Labrosse, "MicroC/OS – II The Real Time Kernel", 2 <sup>nd</sup> Edition, CMP Books, UK, 2015.
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**REFERENCES:**

1.	Rajkamal, "Embedded Systems Architecture, Programming and Design", 3 <sup>rd</sup> Edition, McGraw-Hill, New Delhi, 2014.
2.	Gabriela Nicolescu, Pieter J. Mosterman, "Model-Based Design for Embedded Systems ", 1 <sup>st</sup> Edition, CRC Press, UK, 2017.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	comprehend the fundamental concepts and scheduling algorithms for real time applications	Understanding (K2)
CO2	illustrate the characteristics of task management	Understanding (K2)
CO3	elucidate the working of time and event management of tasks.	Understanding (K2)
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	2	1										3	1	
CO2	2	1										3	1	
CO3	3	1							2			1	3	
CO4	3	2	1	1	2				2	2	2	2	3	1
CO5	3	2	1	1	3				3	3	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	20	80					100
CAT2	20	80					100
CAT3	5	35	60				100
ESE	15	50	35				100

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



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECE25 - 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	7	PE	3	0	0	3

Preamble	To learn the foundations of deep learning algorithms from a simple perceptron to complex models used for image and text processing	
Unit - I	Neurons :	9
MP Neuron – Perceptron – Perceptron Learning Algorithm – Convergence – Multi Layer perceptron – Representational power – Sigmoid neuron –Application to prediction		
Unit - II	ANN and Back propagation:	9
Gradient Descent- Feed forward neural networks - Representational power - Back propagation with respect to : Loss, Intermediate nodes, Input - Application to binary classification		
Unit - III	Optimization :	9
Introduction to Optimization – Convex Optimization - Drawback of Gradient Descent – Momentum based GD - Nesterov Accelerated GD – Stochastic GD- mini batch GD-learning rate schedulers.		
Unit - IV	Regularization:	9
Vanishing and exploding gradients-Activation functions (tanh, relu ,leaky relu)-bias-variance tradeoff – L2-Regularization- Batch Normalization –Dropout- Initialization Strategies.		
Unit - V	Advanced Architectures:	9
CNN-Basic of Convolution – Cross entropy loss – Architectures: LeNet - AlexNet .Resnet, RNN: BPTT – LSTM - GRU–Transformers. Applications to vision and speech.		

**Total:45**

**TEXT BOOK:**

1. Ian Goodfellow, "Deep Learning", 1<sup>st</sup> Edition, MIT Press, 2017.

**REFERENCES:**

1. Raul Rojas, "Neural Networks : A systematic Introduction", 1<sup>st</sup> Edition , Springer,1996
2. <http://neuralnetworksanddeeplearning.com/>



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	use multilayer Perceptron and its learning algorithm for linearly non-separable problems.	Applying (K3)
CO2	apply the back propagation algorithms to learn the parameters of feed forward neural networks.	Applying(K3)
CO3	use various optimization algorithms to update model parameters.	Applying (K3)
CO4	apply regularization and different hyper parameter tuning strategies to improve the performance of the models	Applying (K3)
CO5	make use of CNN and RNN architectures to speech and vision related application.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		2				2			1	3	
CO2	3	2	1		2							2	3	
CO3	3	2	1		2							2	3	
CO4	3	2	2		3							2	3	
CO5	3	2	2	2	3	2		2	2	1		2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20ECE26 - 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 understand verification of IP & sub-system that demands constrained random verification.	
Unit - I	Verification Guidelines	9
Introduction, The Verification Process, The Verification Plan, The Verification Methodology, Manual, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance.		
Unit - II	Data Types	9
Introduction to data types, 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.Array manipulation methods, Array querying functions, Queue.		
Unit - III	Procedural Statements and Routines	9
Introduction, Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview,Routine Arguments, Returning from a Routine, Local Data Storage, Time Values. Process and process control.		
Unit - IV	Basic OOPs	9
Introduction, Think of Nouns, not Verbs, Your First Class, Where to Define a Class, OOP Terminology,Creating New Objects, Object Deallocation, Using Objects, Static Variables vs. Global Variables, ClassRoutines, Defining Routines Outside of the Class, Scoping Rules, Using One Class Inside Another,Understanding Dynamic Objects, Copying Objects, Public vs. Private Straying Off Course, Building aTestbench.		
Unit - V	Connecting the Test bench and Design	9
Introduction, Separating the Testbench and Design, The Interface Construct, virtual interface, Stimulus Timing, Interface Driving and Sampling, Connecting It All Together, Top-Level Scope, Program – Module Interactions, SystemVerilog Assertions, Call back. The Four-Port ATM Router. Modport and Clocking block. Mailbox.		

**Total:45****TEXT BOOK:**

1.	Chris Spear, "SystemVerilog for Verification: A Guide to Learning the Test bench Language Features", 2 <sup>nd</sup> Edition, Springer, USA, 2008.
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**REFERENCES:**

1.	Stuart Sutherland, Simon Davidmann, "System Verilog for design: a guide to using System Verilog for hardware design and modeling", Springer, 2004.
2.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and synthesis", 2 <sup>nd</sup> Edition, Pearson Education, New Delhi, 2017.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	elaborate a scenario for verification of a DUT in System Verilog.	Understanding (K2)
CO2	understand different kinds of datatypes used in system Verilog	Understanding (K2)
CO3	distinguish between HDL and HVL	Understanding (K2)
CO4	design test bench to verify the functionality of a design	Applying (K3)
CO5	understand the concept of randomization and its importance in verification coverage in a complex design	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	1			2				1	1	3
CO2	3	2	2	2	1			3				1	1	3
CO3	3	1	1	1	1			2				1		2
CO4	3	2	2	2	1			3				1	1	3
CO5	3	2	2	2	1			2				2		1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	40	50				100
ESE	20	50	30				100

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



**20ECE27 - 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, Example: Simple and Complex, Advanced Operators		
Unit - II	Text Tokenization and Normalization:	9
Words, Corpora, Word tokenization and normalization, Word segmentation, Sentence segmentation, Minimum edit distance algorithm		
Unit - III	Language Modelling:	9
N-Grams, Evaluating Language Modelling, Smoothing algorithm		
Unit - IV	Logistic Regression as Language Model:	9
Training the Naïve Bayes, Optimizing for sentimental analysis, Naïve Bayes as language modelling, 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****TEXT BOOK:**

1.	Jurafsky, Daniel Martin & James H, "Speech and Language Processing - An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 3 <sup>rd</sup> Edition, Pearson Education India, New Delhi, 2019.
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**REFERENCES:**

1.	Eisenstein & Jacob, "Natural Language Processing", 1 <sup>st</sup> Edition, MIT Press, USA, 2019.
2.	PalashGoyal, Sumit Pandey & Karan Jain, "Deep Learning for Natural Language Processing: Creating Neural Networks with python", 1 <sup>st</sup> Edition, Apress Media, New York, 2018.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	1	1	3		1		1	1			1	1
CO4	3	2	1	1	3		1		1	1			1	1
CO5	3	2	1	1	3		1		1	1			1	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
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)

**20ECE28 - INDUSTRY 4.0**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Microprocessor and Microcontroller</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	This course provides an overview and fundamentals of industry 4.0 -IIoT revolutions, technology and its business use case.	
Unit - I	Overview of 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	IIoT 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 and Technologies	9
Sensors: Introduction – characteristics – Categories. Actuators: Thermal, Hydraulic, Pneumatic,ElectromechanicalActuators. Industrial Data Transmission: Fieldbus – Profibus –HART – Modbus – CAN – DeviceNet – LoRA – NB-IoT - Distributed Control System – PLC - SCADA.		
Unit - V	IIoT 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 Tings and Industry 4.0”, 1 <sup>st</sup> Edition, CRC Press, USA, 2021.
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**REFERENCES:**

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 1 <sup>st</sup> Edition, APress; 2016.
2.	Alp Ustundag, Emre Cevikcan , “Industry 4.0: Managing the Digital Transformation”, 1 <sup>st</sup> Edition, Springer International Publishing AG, 2018.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	summarizes the concepts and business opportunities of Industry 4.0	Understanding (K2)
CO2	explain the role IoT and IIoT architecture for Industry 4.0	Understanding (K2)
CO3	differentiate applications of various recent technologies in the implementation of Industry 4.0	Understanding (K2)
CO4	determine the applications of sensors, actuator and modern embedded bus technologies	Applying (K3)
CO5	examine 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	1					1						1	2
CO2	2	1	1	1				1					1	1
CO3	3	2	3		3	1				1	1		2	2
CO4	3	3	3	2	2	1	1	1	1	1	1		2	2
CO5	2	3	2	3	1	1	2		1	1			2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	30	70					100
CAT2	30	70					100
CAT3	10	50	40				100
ESE	10	60	30				100

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



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 acquire technological insight into 5G network and its associated technologies	
Unit - I	Introduction to 5G:	9
Mobile communication generation from 1G to 4G, 5G requirements, 5G architecture – NFV, SDN, RAN, Functional architecture and 5G flexibility, 5G frequency bands		
Unit - II	Use cases of 5G:	9
Machine Type Communications: fundamental techniques, URLLC-MTC, D2D communications: Radio Resource Management, Millimeter wave communication – hardware technologies		
Unit - III	5G Radio Access Technology:	9
Multicarrier with filtering: FBMC, NOMA, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine-type communication		
Unit - IV	: Spectrum and Channel Models:	9
Spectrum access modes and sharing scenarios, 5G spectrum technologies, Channel modeling requirements and scenarios, The METIS channel models		
Unit - V	Antenna Techniques:	9
Massive MIMO : Single user MIMO , Multi user MIMO , Pilot design for massive MIMO - pilot-data trade-off and impact of CSI, Techniques to mitigate pilot contamination ,Resource allocation and transceiver algorithms for massive MIMO, Introduction to beamforming		

**Total:45****TEXT BOOK:**

1. Afif Osseiran, Jose F.Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", 1<sup>st</sup> Edition, Cambridge University Press, 2016.

**REFERENCES:**

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", 1<sup>st</sup> Edition, John Wiley & Sons, 2015.
2. Patrick Marsch, Omer Bulakçı, Olav Queseth and Mauro Boldi, "5G System Design-Architectural and Functional Considerations and Long Term Research", 1<sup>st</sup> Edition, John Wiley & Sons, 2018.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	interpret the concepts of 5G networks.	Understanding (K2)
CO2	infer the use cases and requirements for 5G	Understanding (K2)
CO3	comprehend the radio access technologies used in 5G	Understanding (K2)
CO4	apply the spectrum optimization algorithms for 5G based CRN	Applying (K3)
CO5	comprehend massive MIMO implementation in 5G networks.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
CO1	3	2	2							2	2			
CO2	3		2	2						2	2			
CO3	3	2	2	2						2	2	2		
CO4	3	2		2						2		2		
CO5	3	3	2	2							2	2	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	25	75					100
CAT2	25	75					100
CAT3	20	60	20				100
ESE	20	60	20				100

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

**20ECE30 – CYBER PHYSICAL SYSTEMS**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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		
Unit - II	Modeling Dynamic Behaviors:	9
Continuous Dynamics-Newtonian Mechanics- Actor Models- Properties of Systems- Feedback Control. Discrete Systems- Finite-State Machines- Extended State Machines- Non-determinism- Behaviors and Traces-Hybrid Systems- Modal Models- Classes of Hybrid Systems. <b>Composition of State Machines-</b> 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 Systems	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 Systems Approach", The MIT Press, 2 <sup>nd</sup> Edition, Feb, 2017 for units I&II.
2	Raj Rajkumar, Dionisio de Niz , Mark Klein "Cyber-Physical Systems" , Pearson Education, Inc, 1 <sup>st</sup> Edition, 2017 for units III, IV & V.

**REFERENCES:**

1.	Glenn A. Fink, Sabina Jeschke, Houbing Song "Security and Privacy in Cyber-Physical Systems Foundations, Principles, and Applications", 1 <sup>st</sup> Edition , John Wiley & Sons Ltd, 2018.
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<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1									1	1
CO3	2	1				3		3					2	1
CO4	3	2	1	1									2	2
CO5	3	2	1	1									3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	50	40				100

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



**20ECE31 - 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 learn 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 (I to 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. Starting 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", 5 <sup>th</sup> Edition, Edward Arnold Publishers, London, 2018.
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**REFERENCES:**

1.	Hollembeak & Barry, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, New York, 2002.
2.	Tim & Gilles, "Automotive Engines: Diagnosis, Repair, Rebuilding", 8 <sup>th</sup> Edition, Delmar Publishers, New York, 2017.
3.	Ribbens William B., "Understanding Automotive Electronics", 8 <sup>th</sup> Edition, Butterworth- Heinemann, Burlington, 2017



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	Applying (K3)
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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1			2	3	3	3				2		
CO2	2				2							2		
CO3	3		1	1	3		2					2		
CO4	3	2	1	1	3	2	2					2		
CO5	3	2	1	1	3	3	2	3				3	2	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	40	50				100
ESE	15	50	35				100

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



Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECE32 - PRINCIPLES OF MACHINE LEARNING**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Linear Algebra and Transforms, Calculus and Complex Analysis	7	PE	3	0	0	3

Preamble	To understand the principles of machine learning and its applications to classification and prediction problems.	
Unit - I	Random Process:	9
Random variables - Multivariate random variables – Transformation of Random variable -Parameters - Gaussian Distribution - Joint Distributions –Conditional Distributions - Bayesian rule		
Unit - II	Parametric Modeling:	9
Parameter estimation – regression – classification – bias-variance dilemma –Regularization-Maximum likelihood – Bayesian Inference-Curse of dimensionality – Validation		
Unit - III	Classification:	9
Bayesian Classification – Naïve Bayes - Decision Surfaces – Logistic regression – Scatter Matrices – Fisher discriminant: Two class,Multiclass – Ada-Boost – Log-Loss function		
Unit - IV	Convex functions:	9
Convex sets and functions – Properties of Projections – Application to classification and regression – Online learning cases		
Unit - V	Sparsity-Aware Learning :	9
Norms – LASSO - Sparsset solutions-Compressed sensing – Dimensionality reduction – Application to image Denoising.		

**Total:45**

**TEXT BOOK:**

1.	Sergious Theodoridis, "Machine Learning: A Bayesian and optimization perspective", 2 <sup>nd</sup> Edition, Academic Press, USA, 2020.
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**REFERENCES:**

1.	Trevor Hastie, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", 12 <sup>th</sup> Edition, Springer, New York, 2017.
2.	MehryarMohri, "Foundations of Machine Learning", 2 <sup>nd</sup> Edition, MIT Press, USA, 2018.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply concepts from multivariate random process	Applying (K3)
CO2	interpret regression models and measure their performance	Applying (K3)
CO3	use various classification models to solve real world applications	Applying (K3)
CO4	summarize convex functions and its properties	Understanding (K2)
CO5	identify various methods that exploits sparsity in the data.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1					2			2	3	
CO2	3	2	1	1	3				2			2	3	
CO3	3	2	1	1	3				2			2	3	
CO4	2	1							2			2	2	
CO5	2	1			1				2			2	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

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

**20ECE33 - NANOTECHNOLOGY FOR ENERGY SUSTAINABILITY**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	2	0	2	3

Preamble	To impart knowledge on nanotechnology, synthesis of nanomaterials, analysis and its uses in energy storage applications.	
Unit - I	Nanoscience and Technology:	6
Emerging trends in nanoscience and technology, Challenges in nanoscience and technology, carbon age-new form of carbon (CNT to Graphene), Optical, electrical, mechanical, magnetic properties.		
Unit - II	Synthesis of Nanomaterials:	6
Top-Down and Bottom-up approach, Chemical precipitation, Sol-gel synthesis, Microwave heating and Electro deposition, Types of Nanocomposite (i.e. metal oxide and polymer based).		
Unit - III	Structural, Electrochemical Measurements and Analysis:	6
X-ray diffraction, Raman Spectroscopy, BET analysis, Cyclic Voltammetry, Galvanostatic charge and Discharge measurements, Electrochemical Impedance Spectroscopy.		
Unit - IV	Renewable Energy Storage Mechanism	6
Ragone Plot, Batteries: Lithium ion Battery, Supercapacitor: Taxonomy of Supercapacitor, EDLC, PSeudocapactor, Hybrid Supercapacitor.		
Unit - V	Applications of Nanomaterials in Energy Conversion and Storage:	6
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.		

**List of Experiments:**

1.	Simulation and Analysis of Proton Exchange Membrane Fuel Cell
2.	Electrochemical workstation studies for calculating specific capacitance using cyclic voltammetry
3.	Electrochemical workstation studies for calculating specific capacitance, energy density and power density using galvanostatic charge and discharge measurements
4.	Electrochemical workstation studies for calculating ESR and charge transfer resistance using Electrochemical Impedance Spectroscopy
5.	Fabrication and testing of Supercapacitor
6.	Analyze the battery parameters using electrochemical workstation

**Lecture :30, Practical :30, Total: 60****TEXT BOOK:**

1.	Charles P. Poole JR. & Franks. J. Qwens, "Introduction to Nanotechnology", 1 <sup>st</sup> Edition, Wiley India Edition , New Delhi, 2012.
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**REFERENCES/MANUALS/SOFTWARES:**

1.	Mick Wilson & Kamali Kannagara, "Nanotechnology – Basics Science and Emerging Technologies", 1 <sup>st</sup> Edition, Overseas Press , New Delhi, 2005.
2.	Pradeep .T, "Nano the Essential Nanoscience and Nanotechnology", 1 <sup>st</sup> Edition, McGraw hill, New Delhi, 2012.
3.	Linden, "Hand book of Batteries and fuel cells", 4 <sup>th</sup> Edition, McGraw Hill, New Delhi, 2011.
4.	MATLAB/Simulink & OrigaViewer & OrigaMaster



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understand the fundamentals of nanoscience and technology	Understanding (K2)
CO2	apply the methods to synthesize nanomaterials for energy storage devices	Applying (K3)
CO3	comprehend the structural and electrochemical analysis of nanomaterials	Understanding (K2)
CO4	understand the working principles of energy storage devices	Understanding (K2)
CO5	design supercapacitor, fuel cell and batteries	Applying (K3)
CO6	simulate and analyze the types of fuel cell	Analyzing (K4) Precision (S3)
CO7	demonstrate the operation of electrochemical workstation and analyze the electrochemical measurements	Analyzing (K4) Articulation (S4)
CO8	fabricate supercapacitor device and analyze the electrochemical measurements	Analyzing (K4) Articulation (S4)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2												3
CO2	3	2	2											3
CO3	3													2
CO4	3													3
CO5	3	2	2											3
CO6	3	3	3		3		2				3			3
CO7	3	3			3						3			
CO8	3	3	3		3		3				3			3

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	10	30	50				100
CAT3	15	45	40				100
ESE	15	45	40				100

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

**20ECE34 - SOFTWARE QUALITY ASSURANCE AND TESTING**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>7</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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 PublishingHouse 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.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	identify the components of software quality assurance systems	Understanding (K2)
CO2	apply the concepts, metrics, and models in software quality assurance	Applying (K3)
CO3	apply the step by step activities and set up environment for software testing	Applying (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	1											1	
CO2	3	2	1	1				1					2	1
CO3	3	2	1	1	3			2				1	2	1
CO4	3	2	1	1	2			2			2	2	2	1
CO5	3	2	1	1	2			2			2	2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	50	20				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	25	30	45				100

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





Kongu Engineering College, Perundurai, Erode – 638060, India  
**20ECE35 - RADAR ENGINEERING**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Antennas and Wave Propagation	8	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						
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<b>Unit - I</b>	<b>Radar and Radar Equation:</b>	<b>9</b>
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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

<b>Unit - II</b>	<b>MTI and Pulse Doppler Radar:</b>	<b>9</b>
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Introduction to Doppler and MTI Radar– Delay line cancelers—Staggered PRF-Doppler filter banks- Moving Target Detector – Limitations to MTI Performance – Pulse Doppler Radar

<b>Unit - III</b>	<b>Tracking Radar:</b>	<b>9</b>
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Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy – Low-Angle Tracking – Tracking in Range –Comparison of Trackers

<b>Unit - IV</b>	<b>Detection of Signals in Noise and Radar Waveform Design</b>	<b>9</b>
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Detection Criteria – Detectors --Automatic Detection – Integrators – Constant-False-Alarm Rate Receivers – The Radar operator – Signal Management  
Theoretical accuracy of radar measurements – Range and Doppler accuracy, uncertainty relation. Pulse compression

<b>Unit - V</b>	<b>Phased Array and Navigational Aids:</b>	<b>9</b>
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Phased Arrays – Basic concepts, feeds, phase shifters, frequency scan arrays, applications, advantages and limitations. Navigational Aids: VOR, ILS and LORAN

**Total:45**

**TEXT BOOK:**

1.	M.I. Skolnik, "Introduction to Radar Systems", 44 <sup>th</sup> Reprint ,McGraw Hill, New Delhi, , 2018.
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**REFERENCES:**

1.	G.S.N. Raju, "Radar Engineering and Fundamentals of Navigational Aids", I.K. International, New Delhi, 2019.
2.	Gottapu Sasi Bhushana Rao, "Microwave and Radar Engineering", 1st Edition, Pearson Education, Chennai, 2014.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	identify the parameters of radar systems	Applying (K3)
CO2	distinguish the pulse doppler radar and MTI radar system	Understanding (K2)
CO3	compare the various types of tracking radar	Understanding (K2)
CO4	infer the method of detecting signals in noise and waveform design	Understanding (K2)
CO5	outline the principle of radar in phased array and navigational aids system	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1			2						2		
CO2	3	1											2	
CO3	3	1	2											
CO4	3	1	2									2		
CO5	3	1	2			2						2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	65	20				100
CAT2	15	85					100
CAT3	15	85					100
ESE	10	70	15				100

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

**20ECE36 - 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 design at the implementation level and to understand the design of Low Noise Amplifiers, Phase Locked Loop, Oscillators and 60 GHz technology	
Unit - I	Transceiver Architectures:	9
Receiver: Homodyne – Heterodyne. Transmitter: Direct up conversion - Two step up conversion 60GHz channel characterization & modeling – Introduction to wireless channel modeling – deterministic & stochastic modeling		
Unit - II	Receiver Design:	9
LNA topologies - Low Noise Amplifiers – Single ended and differential LNAs. PLL: Linearised Model - Phase detectors – Loop filters and charge pumps - Mixer: Characteristics – Multiplier based mixers - Single balanced and active double balanced mixers		
Unit - III	Device Implementation	9
60 GHz Radio Implementation in Silicon – Introduction & Overview – Front End Components – 60 GHz LNAs in SiGe and CMOS – PAs in SiGe and CMOS – Process variability in silicon millimeter wave design – Frequency synthesis and Radio Architectures		
Unit - IV	OFDM based WLAN using 60GHz technology	9
OFDM physical layer implemented on FPGA – design of OFDM physical layer – OFDM baseband receiver architecture – receiver front end – receiver back end – Next generation multi-Gbps OFDM physical layer		
Unit - V	IEEE standards - MAC for 60GHz	9
Design issues in the use of directional antennas - IEEE 802.15.3c MAC for 60GHz – Neighbor discovery – Aggregation and BLOCK – ACK.		

**Total:45****TEXT BOOK:**

1.	Su-khiong (SK) Yong, Pengfei Xia and Alberto Valdes Garcia, "60 GHz Technology – From Theory to Practice", John Wiley and Sons Ltd. Publication, 2011 for units III,IV &V.
2.	Thomas H. Lee, Design of CMOS RF Integrated Circuits, 2nd Edition, Cambridge University Press, UK, 2004 for units I &II.

**REFERENCES:**

1.	Razavi B, "RF Microelectronics", 2 <sup>nd</sup> Edition, Pearson Education, New Delhi, 2011.
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<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	characterize the RF transceiver architecture with channel modelling.	Understanding (K2)
CO2	apply the concepts of RF receiver design	Applying (K3)
CO3	comprehend the issues in the implementation of 60 GHz transmission technology	Understanding (K2)
CO4	apply the concepts of 60GHz technology for the implementation of OFDM in WLAN	Applying (K3)
CO5	apply the concepts of 60 GHz technology for the implementation of WPAN	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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	2									2	1	
CO3	2	1	1										3	
CO4	3	2	2								2		1	
CO5	3	2	2								2		1	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	45	35				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)

**20ECE37 - RISC ARCHITECTURE**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>8</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To understand the principles of interfacing, programming and debugging using ARM Cortex Microprocessors for real time applications	
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- Instruction Set.		
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- CMSIS Core Structure-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- 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		
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**Total:45****TEXT BOOK:**

1.	Joseph Yiu, "The Definitive Guide to ARM_ Cortex_-M3 and Cortex-M4 Processors", 3 <sup>rd</sup> Edition, Newnes, USA, 2014.
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**REFERENCES:**

1.	Trevor Martin, "The Designer's Guide to the Cortex-M Processor Family- A tutorial Approach", 1 <sup>st</sup> Edition, Newnes, USA, 2013.
2.	Trevor Martin, "The Insider's Guide to the STM32 ARM Based Microcontroller", 1 <sup>st</sup> Edition, Hitex(UK) Ltd, UK, 2008.
3.	<a href="http://infocenter.arm.com/help/topic/com.arm.doc.ddi0439b/DDI0439B_cortex_m4_r0p0_trm.pdf">http://infocenter.arm.com/help/topic/com.arm.doc.ddi0439b/DDI0439B_cortex_m4_r0p0_trm.pdf</a>



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	differentiate between the different memory system configurations and interrupt schemes	Understanding (K2)
CO4	develop application programs using floating point operations in ARM Cortex	Applying (K3)
CO5	build OS based applications on ARM Cortex M using Keil MDK.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2												
CO3	3	1												
CO4	3	2	1	1					2	2	2	2	2	1
CO5	3	2	1	1	3				3	3	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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	5	35	60				100
ESE	15	50	35				100

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



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 fundamental concepts of Remote Sensing and Image processing techniques to process the satellite data.						
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<b>Unit - I</b>	<b>Basic concepts and data capturing mechanisms</b>	<b>9</b>
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Basic concepts: Definition, Remote sensing process, Radiation principles, Spectral reflectance curve, EMR interactions with-atmosphere-earth surface features, Resolution types. Data capturing mechanisms: Along track scanning, Across track scanning.

<b>Unit - II</b>	<b>Remote Sensing Platforms:</b>	<b>9</b>
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Space borne, Landsat satellite program, Thematic mapper spectral bands, Landsat image interpretation, Spot satellite program, Spot image interpretation, IRS satellite program, IRS image interpretation, High resolution satellite system, Space station remote sensing, Air borne.

<b>Unit - III</b>	<b>Remote Sensing Types:</b>	<b>9</b>
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Multi spectral scanning, Infrared, Thermal remote sensing, Thermal scanning, radiation principles, Data interpretation, temperature mapping, Hyper spectral scanning, Image analysis techniques, Microwave sensing, Side looking radar systems, Synthetic aperture radar, Radar image characteristics, Radar image interpretation, LIDAR remote sensing, Microwave radiometers, Microwave scanners.

<b>Unit - IV</b>	<b>Satellite image analysis and GIS:</b>	<b>9</b>
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Georeferencing, Enhancement, Feature extraction, Classification. GIS: Spatial data, Attribute data, GIS data integration and analysis.

<b>Unit - V</b>	<b>Applications of Remote Sensing :</b>	<b>9</b>
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Agricultural Applications, Forestry Applications, Rangeland Applications, Water Resource Applications, Snow and Ice Applications, Urban and Regional Planning Applications.

**Total:45**

#### TEXT BOOK:

1.	Thomas M.Lillesand, Ralph W.Kiefer, "Remote Sensing And Image Interpretation", 7 <sup>th</sup> Edition, John Wiley, New Delhi, 2015.
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#### REFERENCES:

1.	John R. Jensen, "Remote Sensing Of The Environment – An Earth Resource Perspective", 2 <sup>nd</sup> Edition, Pearson Education Series, 2003.
2.	Rafael C.Gonzalez, Richard E.Woods, "Digital Image Processing", 3 <sup>rd</sup> Edition, Prentice Hall, 2007.
3.	Robert A. Schowengerdt, "Remote Sensing Models & Methods For Image Processing", 3 <sup>rd</sup> Edition, Academic Press 2007.
4.	J. A. Richards "Remote Sensing Digital Image Analysis: An Introduction", 5 <sup>th</sup> Edition, Springer-Verlag Berlin Heidelberg, 1993.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	describe the electromagnetic remote sensing process and data capturing mechanisms.	Understanding (K2)
CO2	explain the platforms used for data acquiring process.	Understanding (K2)
CO3	understand the different types of remote sensing and radar.	Understanding (K2)
CO4	apply 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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2												
CO3	3	1												
CO4	3	2	1		2	3			2	2		1	2	2
CO5	3	2			2	3	2		2	2		2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					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)



**20ECE39 - COMPUTER DESIGN AUTOMATION FOR VLSI CIRCUITS**

<b>Programme &amp; Branch</b>	<b>B.E - Electronics and Communication Engineering</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>VLSI Design</b>	<b>8</b>	<b>PE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Preamble	To understand the concepts of CAD algorithms for VLSI physical design automation	
Unit - I	Design Methodologies:	9
Introduction to VLSI Design methodologies, Review of VLSI Design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization problems.		
Unit - II	Partitioning and Placement:	9
Placement, Circuit representation, Placement algorithms, Partitioning, Partitioning algorithms, Placement and Partitioning based on Genetic Algorithm		
Unit - III	Floorplanning and Compaction:	9
Floorplanning concepts, shape functions and floorplan sizing, Floorplanning based on Simulated Annealing.Compaction, Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph Compaction.		
Unit - IV	Routing:	9
Types of Local Routing problems, Area routing, Channel routing, Introduction to Global Routing, Steiner tree Construction, Algorithms for Global Routing		
Unit - V	Logic Simulation:	9
Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation. Introduction to Combinational Logic Synthesis, Binary Decision Diagrams, ROBDD, ROBDD principles, implementation, construction and manipulation		

**Total:45****TEXT BOOK:**

1.	Gerez, S.H, "Algorithms for VLSI Design Automation", John Wiley & Sons, New York, Reprint 2008.
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**REFERENCES:**

1.	Naveed Sherwani, "Algorithms for VLSI Physical Design Automation" ,3 <sup>rd</sup> Edition, Springer International Edition, 2013
2.	Sarafzadeh & C.K. Wong, "An Introduction to VLSI Physical Design", McGraw-Hill, New Delhi, Reprint 2007.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	utilize the concepts and properties associated with Graph Theory	Applying (K3)
CO2	infer the concepts of Partitioning and Placement in VLSI physical design process	Understanding (K2)
CO3	demonstrate the concepts of floorplanning, compaction and routing in VLSI physical design	Understanding (K2)
CO4	apply the concepts of design optimization algorithms and their application to VLSI physical design automation	Applying (K3)
CO5	utilize the concepts of simulation in VLSI design automation	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	3	2	2								2	2	
CO3	3	3	2	2								2	2	
CO4	3	3	3	2	2							2	2	
CO5	3	3	2	2								2	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	65	20				100
CAT3	10	50	40				100
ESE	10	40	50				100

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

**20ECE40 - BLOCKCHAIN TECHNOLOGIES**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Data Communication and Networking	8	PE	3	0	0	3

Preamble	To gain knowledge in the theoretical and practical aspects of blockchain technology	
Unit - I	Introduction to Blockchain:	9
Financial transaction – Ledger – trustless system – Elements of blockchain – types – Byzantine General Problems – benefits – challenges – Components and structure of blockchain: blocks – chain – hashing – digital signatures – example – miners – validators – smart contracts - speed – decentralization Vs distributed systems		
Unit - II	Cryptography behind Blockchain:	9
Principles – historical perspectives – classical cryptography- types – symmetric – asymmetric – signatures – hashing. Bitcoin: History – Why bitcoin – keys and addresses – transactions – blocks – bitcoin network – wallets		
Unit - III	Consensus:	9
Practical Byzantine fault tolerance algorithm – Proof of Work - Proof of Stake - Proof of Authority - Proof of Elapsed time Cryptocurrency Wallets: Introduction to cryptocurrency wallets - Transactions - Types of cryptocurrency wallets – Tenancy - Alternate Blockchain		
Unit - IV	Hyperledger and Enterprise Blockchain	9
History - Hyperledger projects - Hyperledger Burrow - Hyperledger Sawtooth - Hyperledger Fabric - Hyperledger Iroha - Hyperledger Indy - Tools in Hyperledger – Deploy a simple application on IBM cloud		
Unit - V	Ethereum:	9
Introducing Ethereum - Components of Ethereum - Ethereum accounts - Ethereum network - Ethereum clients - Ethereum gas - Ethereum virtual machine - Ethereum block – Ether - Basics of Solidity - Ethereum Development		

**Total:45****TEXT BOOK:**

1.	Brenn Hill, Samanyu Chopra, Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", 1 <sup>st</sup> Edition, Packt Publishing, 2018.
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**REFERENCES:**

1.	Brenn Hill, Samanyu Chopra & Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", 1 <sup>st</sup> Edition, Packt publishing, Mumbai, 2018.
2.	Andreas Antonopoulos, "Mastering Bitcoin: Programming the open blockchain", 2 <sup>nd</sup> Edition, O'Reilly Media, USA, 2017.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	discuss the elements, structure and architecture of a blockchain	Understanding (K2)
CO2	describe blockchain cryptography and history of bitcoin	Understanding (K2)
CO3	explain consensus and cryptocurrency wallet	Understanding (K2)
CO4	deploy a simple application using Hyperledger on IBM cloud	Applying (K3)
CO5	develop and analyze a distributed application using Ethereum and Solidity	Evaluate(K5)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			1										
CO2	3	1		2										
CO3	2	1		2	3									
CO4	3	2		3	3								3	1
CO5	3	3	2	3	3								3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	5	30	65				100
CAT3	5	10	45		40		100
ESE	10	20	30		40		100

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

**20ECE41 - QUANTUM COMPUTING AND INFORMATION**

Programme & Branch	B.E - Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Linear Algebra and Transform, VLSI Design	8	PE	3	0	0	3

Preamble	To provide a broad overview of the field of quantum computation and quantum information by describing the fundamental elements and different quantum algorithms. Also it describes general design principles and criteria for good physical implementations of quantum computers.	
Unit - I	Introduction	9
Global perspectives Linear algebra - The postulates of quantum mechanics - Application: superdense coding - EPR and the Bell inequality.		
Unit - II	Quantum circuits	9
Quantum algorithms - Single qubit operations - Controlled operations – Measurement - Universal quantum gates - Quantum circuit model of computation - Simulation of quantum systems.		
Unit - III	The quantum Fourier transform and its applications	9
The quantum Fourier transform - Phase estimation – Order finding and factoring - General applications of the quantum Fourier transform - The quantum search algorithm.		
Unit - IV	Quantum Information	9
Experimental quantum information processing - Quantum information theory - Quantum error-correction - Fault-tolerant quantum computation - Quantum cryptography		
Unit - V	Quantum computers (physical realization)	9
Guiding principles - Conditions for quantum computation - Harmonic oscillator quantum computer - Optical photon quantum computer - Optical cavity quantum electrodynamics - Ion traps - Nuclear magnetic resonance		

**Total: 45****TEXT BOOK:**

1.	Nielsen M.A & Chuang I.L, "Quantum Computation and Quantum Information", 10 <sup>th</sup> Anniversary Edition, Cambridge University Press, UK, 2010.
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**REFERENCES:**

1.	Phillip Kaye, Raymond Laflamme & Michele Mosca, "An Introduction to Quantum Computing", 1 <sup>st</sup> Edition, Oxford University Press, New Delhi, 2010.
2.	Eleanor Rieffel & Wolfgang Polak, "Quantum Computing: A Gentle Introduction", 1 <sup>st</sup> Edition, MIT Press, USA, 2014.
3.	Scott Aaronson, "Quantum Computing Since Democritus", 1 <sup>st</sup> Edition, Cambridge University Press, UK, 2013.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	describe the quantum mechanics using linear algebra	Understanding(K2)
CO2	familiar with qubits and designing of quantum gates	Applying (K3)
CO3	realize the quantum parallelism by using simplest quantum algorithms	Applying (K3))
CO4	understand the basics of quantum information processing	Understanding(K2)
CO5	acquire a basic knowledge on physical realization	Understanding(K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3												
CO2	3	3			2									
CO3	3	3	2		2							2	2	2
CO4	3	2	2	1		2						2	2	2
CO5	3	2	2									2	2	2

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	60	10				100
CAT2	15	60	25				100
CAT3	25	75					100
ESE	15	60	25				100

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



**20ECO01 - WEARABLE TECHNOLOGY**

(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	4	OE	3	1	0	4

Preamble	To understand the concept of wearable sensors, implantables and applications of wearable technology in disease detections.	
Unit - I	Introduction to wearables	9+3
Wearables: Fundamentals, advancements, and a 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	9+3
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	9+3
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	9+3
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	9+3
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		

**Lecture :45, Practical :15, Total: 60**

**TEXT BOOK:**

1.	Sazonov, Edward, "Wearable Sensors: Fundamentals, implementation and applications", Academic Press (Elsevier), 2020.
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**REFERENCES:**

1.	Mukhopadhyay, Subhas C., "Wearable electronics sensors: For safe and healthy living", Vol. 15, Springer, 2015.
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<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understand the concept of wearable technology to differentiate from conventional technologies	Understanding(K2)
CO2	differentiate wearables and implantables	Understanding(K2)
CO3	use wearable sensors for disease detection and diagnosis	Applying(K3)
CO4	interpret the challenges in developing Mechanical and Chemical sensors	Understanding(K2)
CO5	identify wearable sensors employing High frequency	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						
CO3	3		3			2		2				2		
CO4	3		3			2		2				2		
CO5	3		3	1		2		2				2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)





Kongu Engineering College, Perundurai, Erode – 638060, India

**20ECO02 - 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	4	OE	3	1	0	4

Preamble	To understand the working principles of electronics in appliances.	
Unit - I	Introduction to Electronic Components:	9+3
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+3
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+3
The 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+3
Towards industrial and societal automation and digitization, Arrowhead Framework architecture, Engineering of an Arrowhead compatible multidomain 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+3
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 Certification Marks, Means of Protection, Constructive Aspects Related to EMC, Serviceability.		

**Lecture:45, Tutorial:15, Total:60**

**TEXT BOOK:**

1. Westcott, S., & Westcott, J. R, “Basic Electronics: Theory and Practice”, Stylus Publishing, LLC, 2020 for units I & II.
2. William B. Ribbens, “Understanding Automotive Electronics an Engineering Perspective”, 8<sup>th</sup> Edition, Elsevier UAS, 2017 for units III, IV & V.

**REFERENCES:**

1. Steli Loznen, Constantin Bolintineanu, Jan Swart, “Electrical Product Compliance and Safety Engineering”, 1<sup>st</sup> Edition, Artech House Publishers, 2017.
2. BY Jerker Delsing , “IoT Automation - Arrowhead Framework”, 1<sup>st</sup> Edition CRC Press, USA, 2017.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	explain basic electronic components	Understanding(K2)
CO2	demonstrate real life electronic appliances	Understanding(K2)
CO3	conceptualize the connected device architecture	Applying(K3)
CO4	explain electronics in modern automotive	Understanding(K2)
CO5	relate the requirements of safety standard for different products	Understanding(K2)

<b>Mapping of COs with POs and PSOs</b>														
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	2		
CO3	2	2	2	2		2	2	3			2	2		
CO4	2	2	2	2		2	2	3			2	2		
CO5	1	1	2	1		2	2	3			2	3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20ECO03 - PRINCIPLES OF QUANTUM COMPUTING**  
(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	4	OE	3	0	2	4

Preamble	To gain knowledge in the field of quantum computation, different quantum algorithms and its implementation in quantum computers.	
Unit - I	Introduction and overview:	9
Global perspectives - Quantum bits - Quantum computation - Quantum algorithms - Experimental quantum information processing - Quantum information.		
Unit - II	Introduction to quantum mechanics and Introduction to computer science:	9
Introduction to quantum mechanics: Linear algebra - The postulates of quantum mechanics -Application: superdense coding - The density operator. Introduction to computer science: Models for computation - The analysis of computational problems - Perspectives on computer science.		
Unit - III	Quantum circuits:	9
Single qubit operations - Controlled operations – Measurement - Universal quantum gates - Quantum circuit model of computation - Simulation of quantum systems.		
Unit - IV	The quantum Fourier transform and its applications:	9
The quantum Fourier transform - Phase estimation – Order finding and factoring - General applications of the quantum Fourier transform - The quantum search algorithm.		
Unit - V	Quantum computers (physical realization):	9
Guiding principles - Conditions for quantum computation - Harmonic oscillator quantum computer - Optical photon quantum computer - Optical cavity quantum electrodynamics - Ion traps - Nuclear magnetic resonance		

**List of Exercises / Experiments :**

1.	Simulation of single qubit gates
2.	Design and simulation of multi qubit gates
3.	Simulation of measurement error mitigation
4.	Building of Quantum random number generation
5.	Implementation of Shor's algorithm
6.	Implementation of Grover's algorithm

**Lecture:45, Practical:30, Total:75****TEXT BOOK:**

1.	Nielsen M.A & Chuang I.L, "Quantum Computation and Quantum Information", 10 <sup>th</sup> Anniversary Edition, Cambridge University Press, UK, 2010.
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**REFERENCES:**

1.	Phillip Kaye, Raymond Laflamme & Michele Mosca, "An Introduction to Quantum Computing", 1 <sup>st</sup> Edition, Oxford University Press, New Delhi, 2010.
2.	Eleanor Rieffel & Wolfgang Polak, "Quantum Computing: A Gentle Introduction", 1 <sup>st</sup> Edition, MIT Press, USA, 2014.
3.	Scott Aaronson, "Quantum Computing Since Democritus", 1 <sup>st</sup> Edition, Cambridge University Press, UK, 2013.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	perceive the definition of qubit, quantum logic gates, quantum circuits and quantum algorithms.	Understanding (K2)
CO2	Interpret the usage of linear algebra in quantum mechanics	Understanding (K2)
CO3	Interpret qubits and basic quantum gates.	Understanding (K2)
CO4	elucidate the quantum parallelism using simplest quantum algorithms	Understanding (K2)
CO5	classify the schemes for implementation of quantum computers.	Understanding (K2)
CO6	develop quantum logic gate circuits.	Applying (K3), Precision (S3)
CO7	build quantum computing applications using quantum operations	Applying (K3), Manipulation (S2)
CO8	implement quantum algorithm	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	1	1												
CO2	3	3												
CO3	3	3			2									
CO4	3	2	3	2	2							3		
CO5	3	2										3		
CO6	3	2	3	2	3				2	2				
CO7	3	2	3	2	3				2	2				
CO8	3	2	3	2	3				2	2				
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	30	70					100
CAT2	20	80					100
CAT3	20	80					100
ESE	25	75					100

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



**20ECO04 - 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	5	OE	3	0	2	4

Preamble	To understand the different types of Printed Circuit Boards, design concepts, steps to fabricate PCB, different tools for PCB design and component tracing in assembled PCBs	
Unit - I	Introduction to PCB Designing Concepts:	9
Types of Components used in PCB, Terminologies in PCB Designing, Types of PCBs: Single Sided (Single Layer), Double Layer and Multi-Layer PCB, Flexible PCB, Materials for PCB manufacturing		
Unit - II	PCB Design Considerations:	9
PCB Design flow, 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, Token Counter, Wien-bridge Oscillator.		

**List of Exercises / Experiments :**

1.	Study of CAD for PCB Design (Eagle CAD or Equivalent Open Source Tool)
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.	Trouble shooting of single layer and multi-layer PCB

**Lecture:45, Practical:30, Total:75**

**TEXT BOOK:**

1.	Khandpur R.S., "Printed Circuit Board: Design, Fabrication, Assembly and Testing", 1 <sup>st</sup> Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
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**REFERENCES:**

1.	Mehta S.D, "Electronic Product Design", 1 <sup>st</sup> Edition, S Chand Publications, New Delhi, 2011.
2.	Clyde Coombs, "Printed Circuits Handbook", 6 <sup>th</sup> Edition, McGraw Hill Professional, New Delhi, 2007.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	classify the different types of PCBs	Understanding (K2)
CO2	describe the PCB design rules and considerations	Understanding (K2)
CO3	apply the PCB design rules to design and simulate single layer PCB	Applying (K3)
CO4	demonstrate single layer PCB for a given circuit	Applying (K3)
CO5	interpret and trace the assembled electronic components on PCB	Understanding (K2)
CO6	develop the PCB design using a simulation software	Applying (K3), Precision (S3)
CO7	fabricate single layer PCB	Applying (K3), Precision (S3)
CO8	identify and rectify the faults in a PCB	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
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		
CO4	3	2	2		3							2		
CO5	3	3	2		3							2		
CO6	3	3	3		3				2	2		2		
CO7	3	3	3		3			2	2	2		2		
CO8	3	3	3		3				2	2		2		

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50					100
CAT2	20	45	35				100
CAT3	10	35	55				100
ESE	25	40	35				100

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



Programme& Branch	B 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
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-Haar Transform							
Unit - II	Image Enhancement and Restoration:						9
Image Enhancement: Basic intensity transformations – Piecewise linear transformation functions, Histogram equalization - Spatialand 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, Image representation : Chain codes – Boundary descriptors – Regional descriptors, Morphology – dilationand 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", 4 <sup>th</sup> Edition, Pearson Education, New Delhi, 2020						
REFERENCES/ MANUAL / SOFTWARE:							
1.	Jayaraman S, Esakkirajan S &Veerakumar T, "Digital Image Processing", 1 <sup>st</sup> Edition, 22 <sup>nd</sup> Reprint, Tata McGraw Hill, New Delhi, 2018.						
2.	Alan C. Bovik, “The Essential Guide to Image Processing”, 1 <sup>st</sup> Edition, Academic Press, 2009						
3.	Anil K Jain, "Fundamentals of Digital Image Processing", 4 <sup>th</sup> 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)		
CO2	apply Image enhancement in both spatial and frequency domain to improve the quality of images												Applying (K3)		
CO3	use image restoration techniques to restore the original images from noisy images												Applying (K3)		
CO4	identify the features and region of interest of an image using segmentation, representation and description techniques for image classification												Applying (K3)		
CO5	employ image compression algorithms on digital images												Applying (K3)		
CO6	apply conversions and transformation on realtime images												Applying (K3), Precision (S3)		
CO7	enhance the quality of images through various enhancement and restoration techniques for realtime applications												Applying (K3), Precision (S3)		
CO8	apply edge detection and segmentation using morphological operations on 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	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			
CO6	3	2	2	2	3	2			2	2		2			
CO7	3	2	2	2	3	2			2	2		2			
CO8	3	2	2	2	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		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)															





**20ECO05 - 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	6	OE	2	0	2	3

Preamble	To carryout troubleshooting of consumer electronic equipment and to use the testing equipment for testing, analysis and troubleshooting purpose	
Unit - I	Introduction to Troubleshooting and Failure Analysis and Prevention in Electronic Circuits:	6
Troubleshooting Basics - Common Troubleshooting Techniques -Gaining Circuit Familiarity -Getting Prepared for Troubleshooting. Failure Analysis and Prevention in Electronic Circuits: Failure Symptoms -Failure -Causes Failure Types - Some Useful Terms in Failure.		
Unit - II	Device Troubleshooting and Troubleshooting Industrial Controls:	6
Device Troubleshooting: Tools for Servicing- Test and Measuring Instruments- Safety Issues – Test and Tagging of Portable Electrical Equipment. Troubleshooting Industrial Controls: Fundamentals-Types of controllers-Repair and Testing procedures-Preventive Maintenance.		
Unit - III	Troubleshooting Residential ,Wireless Communication Systems:	6
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
Moving from Analog to Digital -Moving into the Digital Circuits - Typical Faults in Digital Systems-Digital Circuit Trouble shooters-Digital Integrated Circuits -Programmable Logic Device (PLD) and Memory Definitions.		
Unit - V	PCB Testing and Soldering Techniques and Maintenance and Safety Aspects:	6
Soldering--Printed Circuit Board -Troubleshooting of Surface Mounted PCBs -Testing and Troubleshooting with ATE. Maintenance and Safety Aspects: Types of Maintenance, Advantages of Preventive Maintenance -Importance of Sound Maintenance Management -Maintenance Policy -Safety Aspects.		

**List of Exercises / Experiments :**

1.	Dismantling and Assembling of electronic hardware.
2.	Study of testing equipment and Troubleshooting of digital circuits
3.	Troubleshooting of speakers and amplifiers
4.	Troubleshooting of home appliances – Radio / TV
5.	Troubleshooting of home appliances – Microwave Oven / Induction Stove
6.	Troubleshooting of wireless communication system – 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.
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**REFERENCES:**

1.	Khandpur .R.S, "Troubleshooting Electronic Equipment: Includes Repair And Maintenance", 2 <sup>nd</sup> Edition, McGraw-Hill Education (India) Private Limited, New Delhi, 2011.
2.	ShashiBhushan Sinha, "Handbook of Repair and Maintenance Of Domestic Electronics Appliances handbook", 1 <sup>st</sup> Edition, BPB Publications, , 2017.
3.	Michael Jaygeier, "How to Dagnose and Fix Everything Electronic", 2 <sup>nd</sup> Edition, McGraw-Hill Education Private Limited, New Delhi, 2015.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	predict the electrical fault in home appliances.	Understanding (K2)
CO4	apply troubleshooting principles for testing of digital circuits.	Applying (K3)
CO5	employ PCB Testing, soldering techniques and summarize maintenance & safety aspects	Applying (K3)
CO6	identify the active and passive components and apply troubleshooting procedures for digital circuits and amplifiers.	Applying (K3), Precision (S3)
CO7	determine the faults and troubleshoot the home appliances using multimeter.	Applying (K3), Precision (S3)
CO8	design a PCB based circuit with troubleshooting.	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2								2	2	
CO2	3	2	1	1	3		1					1	1	
CO3	2	1	3	2	2							3		
CO4	3	2	2	2	2			2					2	
CO5	2	1	2	2	3	1				1		2	2	
CO6	3	3	3	2	3	1			3	2			3	2
CO7	3	3	3	2	2	1			3	2			3	2
CO8	3	3	3	2	1	1			3	2			3	2

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

<b>ASSESSMENT PATTERN - THEORY</b>							
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	10	30	60				100
ESE	20	50	30				100

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

**20ECO06 - BIOINSPIRED COMPUTING TECHNOLOGIES**

(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	2	0	2	3
Preamble	To acquire and familiarize with different types of bio inspired computing techniques for solving optimization problems.						
Unit - I	Introduction:						6
Features of Evolutionary Computation -Advantages of Evolutionary Computation - Applications of Evolutionary Computation. <b>Genetic Algorithms:</b> Introduction - Conventional Optimization and Search Techniques - Advantages and Limitations of Genetic Algorithm-Terminologies and Operators of GA.							
Unit - II	Operators and Applications:						6
Advanced Operators and Techniques in Genetic Algorithm-Classification of Genetic Algorithm-Application of GA in solving combinatorial optimization problems							
Unit - III	PSO Algorithm:						6
PSO Algorithm - Accelerated PSO – Implementation - Convergence Analysis - Binary PSO – Applications. Ant Colony Optimization – Characteristics- Algorithm –Applications.							
Unit - IV	Advanced Optimization Algorithm:						6
Cuckoo Life Style -- flowchart –Algorithm , Bat Algorithms - Echolocation of Bats - Flowchart- algorithm, Bee-Inspired Algorithms – flowchart – algorithm							
Unit - V	Hybrid Optimization Algorithm:						6
Teacher-Learner Based Optimization algorithm-Jaya Algorithm – Hybrid Optimization algorithm (Any Two)							

**List of Exercises / Experiments :**

1.	Solving a cost function using GA tool
2.	Optimization of a cost function using PSO algorithm for an application
3.	Optimization of a cost function using ACO algorithm for an application
4.	Optimization of a cost function using Cuckoo search algorithm for an application
5.	Optimization of a cost function using Bat algorithm for an application
6.	Optimization of a cost function using TLBO /Jaya algorithm for an application

**Lecture:30, Practical:30, Total:60****TEXT BOOK:**

1.	Sivanandam S. N &Deepa S.N, "Introduction to Genetic Algorithms", 1 <sup>st</sup> Edition, Springer, USA, 2008.
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**REFERENCES/MANUALS/SOFTWARES:**

1.	OmidBozorg – Haddad , “Advanced Optimization by Nature-Inspired Algorithms”, Springer, Volume 720, Singapore, 2018.
2.	Srikanta Patnaik, Xin-She Yang & Kazumi Nakamatsu, “Nature-Inspired Computing and Optimization Theory and Applications”, Springer, Volume 10,USA, 2017.
3.	Laboratory Manual



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	infer the concepts of Evolutionary Computation	Understanding (K2)
CO2	relate an optimization problem with GA	Understanding (K2)
CO3	apply the advanced GA operators for machine learning and image processing	Applying (K3)
CO4	apply the concepts of PSO and ACO in optimization problems	Applying (K3)
CO5	infer the concepts of Advanced Search algorithms	Applying (K3)
CO6	experiment the concepts of PSO and ACO using software tools	Applying (K3), Precision (S3)
CO7	experiment the concepts of cuckoo search and bat algorithm using software tools	Applying (K3), Precision (S3)
CO8	experiment the concepts of TLBO and Jaya algorithm using software tools	Applying (K3), Precision (S3)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	3	3		3									
CO3	2	3	3		3									
CO4	3	2	2		3									
CO5	3	2			3									
CO6	3	2	2		3				3					
CO7	3	2	2		3				3					
CO8	3	2	2		3				3					

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

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50					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)



20CO08 – IMAGE PROCESSING (Offered by Department of ECE)							
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
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- 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, Image representation : Chain codes – Boundary descriptors – Regional descriptors, Morphology – dilation and erosion – opening and closing							
Unit - V	Image Compression:						9
Fundamentals: Fidelity Criteria – Types of redundancy – Huffman – 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", 4 <sup>th</sup> Edition, Pearson Education, New Delhi, 2020						
REFERENCES/ MANUAL / SOFTWARE:							
1.	Jayaraman S, Esakkirajan S & Veerakumar T, "Digital Image Processing", 1 <sup>st</sup> Edition, 22 <sup>nd</sup> Reprint, Tata McGraw Hill, New Delhi, 2018.						
2.	Alan C. Bovik, “The Essential Guide to Image Processing”, 1 <sup>st</sup> Edition, Academic Press, 2009						
3.	Anil K Jain, "Fundamentals of Digital Image Processing", 4 <sup>th</sup> 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), 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	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)														



**20ECO07 - OPTICAL ENGINEERING**

(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	-	8	OE	3	0	0	3
Preamble	To study the fundamentals of Optical System Design with emphasis on optical system which are based on lens architectures						
Unit - I	Optics Overview:						9
The Electromagnetic Spectrum – Light Wave Propagation – Snell's Law of Refraction – The Action of Simple Lenses and Prisms on Wave Fronts – Interference and Diffraction – The Photoelectric Effect							
Unit - II	Gaussian Optics:						9
Introduction - Cardinal Points of an Optical System – Image Position and Size – A collection of Imagery Equations – Optical Systems Not Immersed in Air							
Unit - III	Paraxial Optics and Calculations:						9
Refraction of a Light Ray at a single surface – The Paraxial Region – Paraxial Raytracing through several surfaces – Focal Points and Principal Points – The Thin Lens – Mirrors							
Unit - IV	Optical System Considerations:						9
Systems of Separated Components – Focal lengths of two component systems – The Optical Invariant – Matrix Optics – The y-y bar diagram – The Scheimpflug Condition – Summary of sign conventions							
Unit - V	The Basics of Lens Design:						9
Introduction – The Simple Meniscus Camera Lens –The Symmetrical Principle – Achromatic Telescope Objectives – The Diffractive Surface in Lens Design – Third Order Theory							

**Total:45**

**TEXT BOOK:**

1.	Warren J. Smith, Modern Optical Engineering, 4 <sup>th</sup> Edition, McGraw Hill Publication, 2008.
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**REFERENCES:**

1.	Anthony Vanderlugt, "Optical Signal Processing", 1 <sup>st</sup> Edition, Wiley – Interscience, 2005.
2.	B.E.A. Saleh, M.C. Teich, "Fundamentals of Photonics", 2 <sup>nd</sup> Edition, Wiley, 2012



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	characterize and understand the Optical System Design fundamentals	Understanding (K2)
CO2	comprehend the Gaussian Optical system Design principle	Understanding (K2)
CO3	apply the concept of paraxial approximation technique for optical system design	Applying (K3)
CO4	develop optical design considerations for the implementation of Two Component Optical Systems	Applying (K3)
CO5	apply the concepts of optical system design for the development of Lens based Systems	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	20	40	40				100
CAT3	10	30	60				100
ESE	20	40	40				100

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



**20GEO01 – 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	Basics of Language	4/5/7/8	HS	4	0	0	4

Preamble	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	Accommodation (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 <i>sehr/zu</i> , Adjective with Accusative, prepositions with Dative		
Unit - III	Working Environment Communication (ArbeitenSie):	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 – <i>und, oder, aber</i> .		
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 <i>du/Ihr</i> , Modal verbs – <i>sollen, müssen, nichtdürfen, dürfen</i> . Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: <i>man</i> , Question words – <i>Wer, Wen, Was, Wem</i> , Adverbs – <i>Zuerst, dann, Später, ZumSchl</i>		

**Total:60****TEXT BOOK:**

1.	"Stefanie Dengler, Paul Rusch, Helen Schmitz, TanjaSieber, "Netzwerk Deutsch alsFremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.
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**REFERENCES:**

1.	<a href="https://ocw.mit.edu">https://ocw.mit.edu</a> – Massachusetts Institute of Technology Open Courseware Refer: German 1 for undergraduate students
2.	<a href="https://www.dw.com/en/learn-german">https://www.dw.com/en/learn-german</a> - Deutsche Welle , Geramany's International Broadcaster



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understanding letters and simple texts	Remembering (K1)
CO2	assimilating vocabulary on accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understanding how to do shopping in a German store	Understanding (K2)
CO5	understanding 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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	25	75					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)

**20GEO02 – JAPANESE LANGUAGE LEVEL 1**

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering & Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Language	4/5/7/8	HS	4	0	0	4

Preamble	To understand the basics of Japanese language 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 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-110 Kanjis		
Unit - V	Introduction to Counters:	12
How to use numbers-How to use quantifiers-Past form of adjectives and Nouns-Way to say preference-Way of expression degrees of an action-Other necessary particles-How to use numbers-How to use quantifiers-Past form of adjectives		

**Total:60****TEXT BOOK:**

1.	"MINNA NO NIHONGO—Japanese for Everyone", 2 <sup>nd</sup> Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.
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**REFERENCES:**

1.	MargheritaPezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2018.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	read and understand typical expression in Hiragana and Katakana	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	Understanding (K2)
CO5	comprehend concept of time, counters and job-related information	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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
CAT3	25	75					100
ESE	25	75					100

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

**20GEO05 - 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	4/5/7/8	HS	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	Accommodation(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 <i>sehr/zu</i> , 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, Conjunction – <i>und, oder, aber</i> .		
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 <i>du/Ihr</i> , Modal verbs – <i>sollen, müssen, nicht dürfen, dürfen</i> . Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: <i>man</i> , Question words – <i>Wer, Wen, Was, Wem</i> , Adverbs – <i>Zuerst, dann, Später, Zum Schl</i>		

**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.
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**REFERENCES:**

1	<a href="https://ocw.mit.edu">https://ocw.mit.edu</a> – Massachusetts Institute of Technology Open Courseware
2	<a href="https://www.dw.com/en/learn-german">https://www.dw.com/en/learn-german</a> - Deutsche Welle , Germany's International Broadcaster



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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

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

**20GEO06 - 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	4/5/7/8	HS	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.
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<b>Unit - I</b>	<b>All about food (Rund Ums Essen):</b>	<b>9</b>
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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'

<b>Unit - II</b>	<b>School days ( Nach der Schulzeit):</b>	<b>9</b>
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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.

<b>Unit - III</b>	<b>Media in everyday life (Medien in Alltag):</b>	<b>9</b>
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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.

<b>Unit - IV</b>	<b>Feelings and expressions (Gefühle):</b>	<b>9</b>
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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.

<b>Unit - V</b>	<b>Profession and Travel ( Beruf und Reisen):</b>	<b>9</b>
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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.
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**REFERENCES:**

1.	Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2.	<a href="https://www.dw.com/en/learn-german">https://www.dw.com/en/learn-german</a> - Deutsche Welle, Germany's International Broadcaster



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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

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



**20GEO07 - 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	4/5/7/8	HS	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.
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<b>Unit - I</b>	<b>Learning (Lernen):</b>	<b>9</b>
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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, Konjunktiv II: Sollte( suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ, ab+dativ

<b>Unit - II</b>	<b>Athletic (Sportlich):</b>	<b>9</b>
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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

<b>Unit - III</b>	<b>Living Together (Zusammen Leben):</b>	<b>9</b>
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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: Konjunktiv II- könnte, Subordinate clauses – als and Wenn.

<b>Unit – IV</b>	<b>Good Entertainment (Gute Unterhaltung):</b>	<b>9</b>
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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.

<b>Unit - V</b>	<b>Passage of time and Culture (Zeitablauf &amp; Kultur):</b>	<b>9</b>
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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: Konjunktiv 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.
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**REFERENCES:**

1.	Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2.	<a href="https://www.dw.com/en/learn-german">https://www.dw.com/en/learn-german</a> - Deutsche Welle, Germany's International Broadcaster



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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



**20GEO08 - 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	4/5/7/8	HS	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”, 2 <sup>nd</sup> Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.
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**REFERENCES:**

1.	Margherita Pezzopane, “Try N5”, 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, “Japanese Word Speedmaster”, 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2018.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20GEO09 - JAPANESE 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	Japanese Language Level 2	4/5/7/8	HS	3	0	0	3

Preamble	The intermediate level of Japanese which provides understanding of all forms of verbs, 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, Habitual Actions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		

**Total: 45****TEXT BOOK:**

1.	"MINNA NO NIHONGO—Japanese for Everyone", 2 <sup>nd</sup> Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.
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**REFERENCES:**

1.	Margherita Pezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2018.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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

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



**20GEO10 - 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	4/5/7/8	HS	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", 2 <sup>nd</sup> Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.
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**REFERENCES:**

1.	Margherita Pezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2018.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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

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





**20GEO13 - 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	4/5/7/8	HS	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, 1 <sup>st</sup> group of verb		
Unit - IV	In the City:	12
2 <sup>nd</sup> 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
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**REFERENCES:**

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20GEO14 - 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	4/5/7/8	HS	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****TEXTBOOK:**

1.	A2 – Saison
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**REFERENCES:**

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20GEO15 - 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	4/5/7/8	HS	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 |
| 3. | .Les idees – 0 and 1  |



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	learn on Future tense.	Remembering (K1)
CO2	understand Permissions and Prohibitions.	Understanding (K2)
CO3	know about Letter writing, Creating Ads, Expressing Desires, and Instructing Others.	Understanding (K2)
CO4	understand rules for travel and Enhancing communications.	Understanding (K2)
CO5	express the feelings and emotions using advanced grammar	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20GEO16 - 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	5/6/7/8	HS	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 Despedirse):	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 Ciudad):	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 ciudad de salta, 3-28043 MADRID (ESPANA).
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**REFERENCES:**

1.	<a href="https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm">https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm</a>
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<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
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)



**20GEO17 - 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	4/5/7/8	HS	4	0	0	4

Preamble	This course aims to help the Learner to acquire the vocabulary as per the framework of Spanish language A2 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 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 Todavía 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, Agustin 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](https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm)



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	understand the Spanish 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 Comparing them.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)

**20GEO18 - 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	4/5/7/8	HS	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 (Seamos creatives):	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 INTERNACIONAL 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.
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**REFERENCES:**

1.	<a href="https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm">https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm</a>
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<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	learn on Future tense.	Remembering (K1)
CO2	understand about Permissions and Prohibitions.	Understanding (K2)
CO3	know about Letter writing, Creating Ads, Expressing Desires and Instructing Others.	Understanding (K2)
CO4	understand rules for travel and Enhance communications.	Understanding (K2)
CO5	express the feelings and emotions using advanced grammar	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20MAO01 - MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING**  
(Common to all Engineering and Technology Branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	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
Definition – 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 – Rotations.		
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 for Units I, II & III.
2.	M. P. Deisenroth, A. A. Faisal, and C. S. Ong, "Mathematics for Machine Learning", 1 <sup>st</sup> Edition Cambridge University Press, 2019 for Units IV & V.

**REFERENCES:**

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5 <sup>th</sup> Edition, Pearson Education, New Delhi, 2016.
2.	Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning series)", 4 <sup>th</sup> Edition, MIT Press, USA, 2020.
3.	R. O. Duda, E. Hart, and D.G. Stork, "Pattern classification", 2 <sup>nd</sup> Edition, John Wiley & Sons, 2012.



COURSE OUTCOMES:												BT Mapped (Highest Level)		
On completion of the course, the students will be able to														
CO1	understand the concepts of vector spaces.											Understanding (K2)		
CO2	apply the concepts of linear mappings in machine learning.											Applying (K3)		
CO3	understand the concept of inner product space and decompose the given matrix by means of orthonormal vectors.											Understanding (K2)		
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		1	1									
CO5	3	2		2	1									
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
CAT1	10	50	40				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	5	25	70				100

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



**20MAO02 - GRAPH THEORY AND ITS APPLICATIONS**  
(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	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
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 - 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 – Krushkal's algorithm – Optimal assignment – Kuhn and Munkres algorithm.		

**Lecture: 45, Tutorial: 15, Total: 60**

**TEXT BOOK:**

1. NarsinghDeo, "Graph Theory with Applications to Engineering and Computer Science", 1<sup>st</sup> Edition, Dover Publications, New York, 2016, for Units I, II & III.
2. S. Saha Ray, "Graph Theory with Algorithms and Its Applications in Applied Science and Technology", 1<sup>st</sup> Edition, Springer, London, 2013, for Units IV & V.

**REFERENCES:**

1. Douglas B West, "Introduction to Graph Theory", 2<sup>nd</sup> Edition, Pearson Education, New Delhi, 2002.
2. Jonathan L. Gross and Jay Yellen, "Graph Theory and its Applications", 2<sup>nd</sup> Edition, CRC Press, New York, 2006.
3. J.A.Bondy and U.S.R. Murty, "Graph Theory and Applications", 5<sup>th</sup> Edition, Elsevier Science Publishing Co., Inc., New York, 1982.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	understand basic graph theoretic concepts.	Understanding (K2)
CO2	interpret 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	1											
CO5	3	2	1											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	50	40				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	35	55				100

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



**20MAO03 - DATA ANALYTICS USING R PROGRAMMING**

(Common to all Engineering and Technology Branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

Preamble	To impart the basic knowledge in R and develop skills to apply the knowledge of R programming to statistical 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 loop – while loop – Function: Creating a function – calling a function – Default value for function arguments – Logical functions – Math 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 fitting.		
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: Scatter 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 – Correlation and covariance – Tests for association – Analysis of variance: One-way ANOVA – Two-way ANOVA.		

**Total: 45****TEXT BOOK:**

1.	Kun Ren, "Learning R Programming", 1 <sup>st</sup> Edition, Packt Publishing Ltd, UK, 2016, for Units I, II.
2.	Mark Gardener, "Beginning R-The Statistical Programming Language", 1 <sup>st</sup> Edition, John Wiley & Sons Inc., USA, 2012 for Units III, IV & V.

**REFERENCES:**

1.	Seema Acharya, "Data Analytics using R", 1 <sup>st</sup> Edition, McGraw Hill Education, Chennai, 2018.
2.	Norman Matloff, "The Art of R Programming", 1 <sup>st</sup> Edition, No Starch Press, San Francisco, 2011.
3.	Paul Teetor, "R Cookbook", 1 <sup>st</sup> Edition, O'Reilly Media, USA, 2011.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	understand the basics of fundamentals of R.	Understanding (K2)
CO2	understand the concepts of decision, looping structures and functions.	Understanding (K2)
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20MAO04 - NUMBER THEORY AND CRYPTOGRAPHY**  
(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

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	<b>Divisibility Theory and Canonical Decompositions:</b>	<b>9</b>
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	<b>Theory of Congruences:</b>	<b>9</b>
Basic concepts – Properties of congruences – Linear congruences – Solution of congruences – Fermat's Little theorem – Euler's theorem – Chinese remainder theorem.		
Unit - III	<b>Number Theoretic Functions:</b>	<b>9</b>
Introduction – Functions $\tau$ and $\sigma$ – Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.		
Unit - IV	<b>Primality testing and Factorization:</b>	<b>9</b>
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	<b>Classical Cryptographic Techniques:</b>	<b>9</b>
Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography.		

**Total: 45**

**TEXT BOOK:**

1.	Thomas Koshy, "Elementary Number Theory with Applications", 2 <sup>nd</sup> Edition, Academic Press, Elsevier, USA, 2007, for Units I,II,III.
2.	William Stallings, "Cryptography and Network Security: Principles and Practice", 7 <sup>th</sup> Edition, Pearson Education, New Delhi, 2019, for Units IV,V.

**REFERENCES:**

1.	Ivan Niven, Herbert S. Zuckerman, 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, 1 <sup>st</sup> Edition, New Delhi, 2010.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20MAO05 -ADVANCED LINEAR ALGEBRA**  
(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	To provide the skills for solving linear equations, decomposition of matrices and linear transformations in real time engineering problems and impart knowledge of vector spaces.	
Unit - I	Linear Equations:	9
System of linear equations – Row reduction and echelon forms – Vector equations – Matrix equations – Solution sets of linear systems – Applications of Linear systems: Matrix operations – inverse of a matrix, Matrix factorization – Applications to computer graphics.		
Unit - II	Vector Spaces:	9
Definition – Subspaces – Linear independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit - III	Inner Product Spaces:	9
Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Least square technique.		
Unit - IV	Linear Transformations:	9
General linear transformation – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - V	Quadratic form and Matrix Decomposition:	9
Quadratic forms – Quadratic surfaces – Hermitian, Unitary and Normal matrices – LU decomposition – Singular value decomposition.		

**Total: 45**

**TEXT BOOK:**

1.	Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, New Delhi, 2014.
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**REFERENCES:**

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5 <sup>th</sup> Edition, Pearson Education, New Delhi, 2016.
2.	Gareth Williams, "Linear Algebra with Applications", 9 <sup>th</sup> Edition, Jones & Bartlett Publishers, Canada, 2017.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply the concepts of matrices and vectors in solving the system of linear equations.	Applying (K3)
CO2	understand the concept of vector spaces.	Understanding (K2)
CO3	apply the concept of inner product spaces in orthogonalization.	Applying (K3)
CO4	apply the concepts of linear transformation to engineering problems	Applying (K3)
CO5	apply the knowledge of quadratic forms and matrix decompositions in practical 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	1											
CO4	3	2	1											
CO5	3	2	2											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	40	50				100
CAT3	10	20	70				100
ESE	10	30	60				100

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



**20MAO06 - OPTIMIZATION TECHNIQUES**  
(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	To provide the skills for solving the real time engineering problems involving linear and non-linear problems and also impart knowledge in project management and game theoretic concepts.	
Unit - I	Linear Programming:	9
Introduction – Formulation of Linear Programming Problem – Basic assumptions – Limitations of Linear Programming models – Standard form of LPP – Graphical Method – Simplex Method – Artificial variable techniques – Big M Method.		
Unit - II	Transportation and Assignment problems:	9
Transportation problem: Mathematical Formulation of Transportation Problem – Initial basic feasible solution – North West Corner Method – Least Cost Method – Vogel's approximation method – Optimal solution – MODI Method – Degeneracy – Unbalanced transportation problem – Maximization transportation problem. Assignment Problem: Mathematical model of Assignment problem – Hungarian Method – Unbalanced assignment problem.		
Unit - III	Theory of Games:	9
Two-person zero-sum game – Pure strategies - Game with mixed strategies – Rules of Dominance – Solution methods: Algebraic method – Matrix method – Graphical method.		
Unit - IV	Network Scheduling:	9
Basic Concept of network Scheduling – Construction of network diagram – Critical path method – Programme evaluation and review technique – Project crashing – Time-cost trade-off procedure.		
Unit - V	Non-Linear Programming:	9
Formulation of non-linear programming problem – Constrained optimization with equality constraints – Kuhn-Tucker conditions – Constrained optimization with inequality constraints.		

**Total: 45**

**TEXT BOOK:**

1.	Hamdy A. Taha, "Operations Research: An Introduction", 10 <sup>th</sup> Edition, Dorling Kindersley, Pvt. Ltd, Uttar Pradesh, 2016.
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**REFERENCES:**

1.	Sharma J.K, "Operations Research – Theory and Applications", 4 <sup>th</sup> Edition, Macmillan Publishers India Ltd, New Delhi, 2009.
2.	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 6 <sup>th</sup> Edition, S.Chand and Co. Ltd., New Delhi, 2008.
3.	KantiSwarup, Gupta P.K. and Man Mohan, "Operation Research", 14 <sup>th</sup> Edition, Sultan Chand & Sons, New Delhi, 2014.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	solve linear programming problems.	Applying (K3)
CO2	apply transportation algorithms in engineering problems	Applying (K3)
CO3	use assignment and game theory concepts in practical situations	Applying (K3)
CO4	handle the problems of Project Management using CPM and PERT	Applying (K3)
CO5	solve various types of Non-linear Programming 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	1											
CO3	3	1												
CO4	3	2	1											
CO5	3	2	1											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)





**20PHO01 - THIN FILM TECHNOLOGY**  
(Common to all Engineering and Technology branches)

<b>Programme &amp; Branch</b>	<b>All BE / BTech Branches</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>4</b>	<b>OE</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

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 for Units I, II, III & IV.
2	Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, 1 <sup>st</sup> edition, CRC Press, Boca Raton, 2008, for 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



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20PH002- HIGH ENERGY STORAGE DEVICES**  
(Common to all Engineering and Technology branches)

<b>Programme &amp; Branch</b>	<b>All BE / BTech Branches</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>5</b>	<b>OE</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

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 and Optical storage:	9+3
Magnetic storage: Principle of operation, Emerging challenges and a review on devices and technology. Electro-optic and Optical storage: Principles of operation, Device fabrication, Emerging devices and Upcoming technologies.		
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 1- 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, Elsevier, 2016
3.	D. Linden and T. S. Reddy, Handbook of Batteries, McGraw Hill, Newyork, 2002



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	Utilize the principle of operation of magnetic storage systems, electro-optic and optical storage systems to illustrate the respective device fabrication 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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20PHO03 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS**  
(Common to all Engineering and Technology branches)

<b>Programme &amp; Branch</b>	<b>All BE / BTech Branches</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>6</b>	<b>OE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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
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, Strain calculation - Applications of X ray diffraction measurements.		
Unit - II	Electron Microscopy:	9
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, Short details of each component and working – Field emission scanning electron microscope – Different types of filaments - Wavelength dispersive x-ray analysis – Three parameter equation for quantitative composition analysis.		
Unit - III	Scanning Tunneling Microscopy:	9
Introduction to quantum mechanical tunneling - Basic principles of scanning tunneling microscopy - Two modes of scanning - Interpreting scanning tunneling microscopic images -Applications of scanning tunneling microscopy.		
Unit - IV	Raman Spectroscopy:	9
Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation – Near-Infra-Red FT Raman Spectroscopy.		
Unit - V	Ultra Violet &Visible Spectroscopy:	9
Regions of UV-Visible radiation - Colour and light absorption - The chromophore concept - Beer's and Lambert's laws – Theory of electronic transition - Frank Condon principle – Instrumentation and Working of UV vis spectrometer - Applications of UV visible spectroscopy.		

**Total: 45**

**TEXT BOOK:**

1.	Cullity B. D. and Stock S. R, Elements of X-ray diffraction, 3 <sup>rd</sup> Edition, Pearson Education, India, 2003 (Unit I)
2	Banwell C. N, McCash E. M, Choudhury H. K, Fundamentals of Molecular Spectroscopy, 5 <sup>th</sup> 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, 1 <sup>st</sup> 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 7 <sup>th</sup> Edition, Wadsworth Publishing Company, United States, 1988
3.	Elton N. Kaufman, Characterization of Materials (Volume1&2), 2 <sup>nd</sup> , Wiley-Interscience, New Jersey, 2012



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20CYO01 - INSTRUMENTAL METHODS OF ANALYSIS**  
(Common to all Engineering and Technology branches)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	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 – elucidation of 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 Emission 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.
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**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.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)





**20CYO02 - CORROSION SCIENCE AND ENGINEERING**  
(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	Corrosion science and engineering aims to equip the students to have a wide-range knowledge of corrosion and prevention methods in order to meet the industrial needs.	
Unit – I	Corrosion and its Units	9+3
Localized corrosion: 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 Galvani series - pilling Bedworth's ratio and it consequences (Problems) – units 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 corrosion		
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 – Their and limitations–Methods of Determining Corrosion Rates - Weight Loss Method, Weight Gain Method and Chemical Analysis of Solution.		
Unit - III	Types of Corrosion	9+3
Introduction - (i) Crevice - differential aeration corrosion, (ii) pitting – mechanism, factors (iii) intergranular- chromium depletion theory, weld decay and knife line attack, (iv) stress - SCC mechanism, and fatigue- Cavitation damage – Fretting damage, (v) stray current corrosion - causes and its control.		
Unit - IV	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 – V	Prevention of Corrosion	9+3
Inhibitors – types of inhibitors, chemisorption of inhibitors, effect of concentration, effect of molecular structure, V.P. 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		

**Lecture: 45, Tutorial: 15, Total: 60**

**TEXT BOOK:**

1. E. McCafferty, Introduction to Corrosion Science, 2<sup>nd</sup> Edition, Springer, 2017.

**REFERENCES:**

1. R. Winston, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Revie 4<sup>th</sup> Edition, Wiley publisher, 2008.
2. Fontanna, "Corrosion Engineering", (Materials Science and Metallurgy series), McGraw Hill international Ed., 2005.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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	organize the various types of corrosion to understand the corrosion problems	Applying (K3)
CO4	utilize the theories corrosion to interpret with the real time applications	Applying (K3)
CO5	summarize the corrosion prevention methods to avoid corrosion related issues	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20CYO03 - CHEMISTRY OF COSMETICS IN DAILY LIFE**  
(Common to all Engineering and Technology branches)

<b>Programme &amp; Branch</b>	<b>All BE/BTech Branches</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>5</b>	<b>OE</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

Preamble	This course aims to provide knowledge for engineering students on chemistry of cosmetics.	
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) - Polymers in Cosmetics - Polymer Solubility and Compatibility, polymer conformation - 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 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 - Precautions on Cosmetic Ingredients - Future Challenges in Cosmetics Material Development.		
Unit 3	Polymers in Cosmetic Products	9+3
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	Powders and Fragrance in Cosmetics	9+3
Inorganic Pigments – extender pigment, coloured pigment, white pigment, pearlescent Pigments – organic pigments - extender pigment, coloured pigment. Fragrance – Introduction – natural products – aroma chemicals - fragrance creation and duplication - fragrance applications - encapsulation and controlled release – malodor - natural, green, organic, and sustainable fragrances.		
Unit 5	Preparation of Cosmetics	9+3
Brief introduction of the following cosmetic preparation and a detailed study on their quality control: shampoo, tooth paste, skin powder, skin creams, hair creams, nail polish, after shave lotion, bath and toiletries, lipstick and hair dyes, perfumes, depilatories.		

**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, JayeshGadiya, MeenakshiDhanawat 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.



<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
CO1	outline the formulation of cosmetics products	Understanding (K2)
CO2	identify the structuring materials form cosmetics	Applying (K3)
CO3	interpret the polymers in cosmetics	Understanding (K2)
CO4	develop knowledge about Powders and Fragrance in Cosmetics	Applying (K3)
CO5	apply the preparation methodology of cosmetics to explain the preparation and quality control of different cosmetic products used in day to day life.	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20CYO04 - CHEMISTRY OF NUTRITION FOR WOMEN HEALTH**  
(Common to all Engineering and Technology branches)

<b>Programme&amp; Branch</b>	<b>All BE/BTech Branches</b>	<b>Sem.</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>Prerequisites</b>	<b>Nil</b>	<b>5</b>	<b>OE</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

<b>Preamble</b>	This course aims to provide knowledge for engineering students on components of health and fitness and the role of nutrition for women health.
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<b>Unit - I</b>	<b>Nutrition</b>	<b>9+3</b>
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Energy- Functions, sources and concept of energy balance, Functions, 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

<b>Unit - II</b>	<b>Role of women in national development</b>	<b>9+3</b>
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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.

<b>Unit - III</b>	<b>Women and health</b>	<b>9+3</b>
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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.

<b>Unit - IV</b>	<b>Nutrition during Lactation and for Infants</b>	<b>9+3</b>
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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.

<b>Unit - V</b>	<b>Physical fitness and nutrition</b>	<b>9+3</b>
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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.

**Lecture:45,Tutorial:15, Total: 60**

**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.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	Make use of the knowledge of dietary sources in day to day life	Applying (K3)
CO2	Interpret the various role of women in society	Understanding (K2)
CO3	Explain the disease pattern and policies towards women health	Understanding (K2)
CO4	Develop knowledge about nutrition during lactation and for infants	Applying (K3)
CO5	Utilize the knowledge of physical fitness and nutrition towards achieving a good health	Applying (K3)

<b>Mapping of COs with POs and PSOs</b>														
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	1											
CO5	3	2	1											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

<b>ASSESSMENT PATTERN - THEORY</b>							
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)



**20CYO05 - CHEMISTRY CONCEPTS FOR COMPETITIVE EXAMINATIONS**  
(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

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
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
<b>Chemical Equations:</b> Types of ions and radicals- oxidation and reduction-redox reactions - Balancing ionic equations. <b>Chemical Bonding:</b> 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
<b>Acid- base theory</b> – 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. <b>Metallurgy:</b> 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
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
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.		

**Total: 45****TEXT BOOK:**

1.	Steven S. Zumdahl, Susan A. Zumdahl and Donald J. DeCoste , “Chemistry”, 10th Edition, Cengage Learning, 2018, for Units-I, II, III, IV.
2.	Wiley editorial board. "Wiley Engineering Chemistry". 2 <sup>nd</sup> 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, 33 <sup>rd</sup> Edition, Vishal Publishing Co., 2020.
2.	Paula Bruise, “Organic Chemistry”, 6th Edition, 8 <sup>th</sup> Edition, Pearson Education, 2020.







<b>COURSE OUTCOMES:</b> On completion of the course, the students will be able to		<b>BT Mapped (Highest Level)</b>
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 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)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/Pos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
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)



**20CYO06 - WASTE AND HAZARDOUS WASTE MANAGEMENT**  
(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	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
<b>Solid wastes:</b> 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
<b>Hazardous wastes:</b> definition, nature and sources of hazardous waste, classification and characteristics of hazardous waste-chemical class of hazardous waste, segregation of waste-generation, 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
<b>E-Waste Management:</b> Definition, sources, classification, collection, segregation, treatment and disposal. <b>Biomedical Waste Management :</b> 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, dairy industries.		
Unit - V	SOLID WASTE MANAGEMENT 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 distributors, New delhi, 2002 for Units - 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" 1 <sup>st</sup> Edition, Butterworth-Heinemann, 2019.



<b>COURSE OUTCOMES:</b>		<b>BT Mapped (Highest Level)</b>
On completion of the course, the students will be able to		
CO1	apply the technical points that are required to set up a solid waste management system.	Applying (K3)
CO2	select the various disposal methods of hazardous wastes like radioactive wastes	Understanding (K2)
CO3	organize the appropriate method for managing e-waste and biomedical waste	Applying (K3)
CO4	identify to plan minimization of industrial wastes	Applying (K3)
CO5	relate the legal legislation to solid waste management.	Understanding (K2)

<b>Mapping of COs with POs and PSOs</b>														
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
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														

<b>ASSESSMENT PATTERN - THEORY</b>							
<b>Test / Bloom's Category*</b>	<b>Remembering (K1) %</b>	<b>Understanding (K2) %</b>	<b>Applying (K3) %</b>	<b>Analyzing (K4) %</b>	<b>Evaluating (K5) %</b>	<b>Creating (K6) %</b>	<b>Total %</b>
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)



**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 Honours degree with specialization in **System on Chip Design**.

<b>S.No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credits</b>	<b>Prerequisites</b>	<b>Semester</b>
1.	20ECJ01	Analog Circuit Design	4	Solid State Devices	5
2.	20ECH01	VLSI Technology	3	Semiconductor Physics	5
3.	20ECH02	VLSI Signal Processing	4	VLSI design	6
4.	20ECH03	Semiconductor Device Modeling	3	Semiconductor Physics	6
5.	20ECJ02	Mixed Signal IC Design	4	VLSI design	7
		<b>TOTAL</b>	<b>18</b>		



20ECJ01 - ANALOG CIRCUIT DESIGN								
Programme & Branch	B.E. & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit	
Prerequisites	Solid State Devices	5/6/7	HN	3	0	2	4	
Preamble	To design and analyze the performance of MOS based Analog VLSI circuits							
Unit – I	Basic MOS Device Physics & Single Stage Amplifiers:						9	
General Considerations, MOS IV characteristics, Second order effects, MOS Device models. Short Channel Effects and Device Models. Single Stage Amplifiers – Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascode Stage.								
Unit – II	Differential Amplifiers & Current Mirrors:						9	
Single Ended and Differential Operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS loads, Gilbert Cell. Passive and Active Current Mirrors – Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors.								
Unit – III	Frequency Response of Amplifiers& Noise:						9	
General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair. Noise – Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in Differential Pairs.								
Unit – IV	Feedback Amplifiers & Operational Amplifiers:						9	
General Considerations, Feedback Topologies, Effect of Loading. Operational Amplifiers – General Considerations, One Stage Op Amps, Two Stage Op Amps, Gain Boosting, Common – Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps. Stability and Frequency Compensation.								
Unit – V	Stability and Frequency Compensation:						9	
General Considerations, Multipole Systems, Phase Margin, Basic Frequency Compensation, Compensation of Two-stage op Amps								
LIST OF EXPERIMENTS / EXERCISES:								
1.	Design Common Source Amplifier with different Loads							
2.	Design Common Gate Amplifier							
3.	Design Common Drain Amplifier							
4.	Design Single stage Cascode Amplifiers							
5.	Design Single stage Cascode Amplifiers with active load							
6.	Design Differential Amplifiers with Different Loads							
7.	Analyse the amplification factor of single stage and multi stage differential amplifier.							
8.	Design Two stage Operational Amplifier							
9.	Design Current Mirrors circuit for Operational Amplifier							
10.	Analyse the stability of two stage Operational Amplifier.							
Lecture:45, Practical:30, Total:75								
TEXT BOOK:								
1.	B.Razavi, “Design of Analog CMOS Integrated Circuits”, 2nd Edition, McGraw Hill Edition 2016.							



REFERENCES/ MANUAL / SOFTWARE:															
1.	Paul. R.Gray & Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley, 5th Edition, 2009.														
2.	T. C. Carusone, D. A. Johns & K. Martin, “Analog Integrated Circuit Design”, 2nd Edition, Wiley, 2012.														
3.	P.E.Allen&D.R. Holberg, “CMOS Analog Circuit Design”, 3rd Edition, Oxford University Press, 2011.														
4.	R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition, Wiley, 2010														
5.	Cadence - Virtuoso														
COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)		
CO1	comprehend the concepts of MOS device physics and single stage amplifiers.													Understanding(K2)	
CO2	design differential amplifiers and current mirrors													Applying (K3)	
CO3	examine the frequency response of amplifiers and the effects of noise in amplifiers													Understanding(K2)	
CO4	design feedback and operational amplifiers													Applying (K3)	
CO5	Infer the stability and frequency compensation of operational amplifiers													Understanding(K2)	
CO6	design and analysis of amplifiers with different loads													Applying(K3), Precision(S3)	
CO7	design and analysis of differential amplifiers with different stages													Applying (K3), Precision (S3)	
CO8	design and analysis the stability of operational amplifiers with different stages													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	2	1		2	2						2			
CO2	3	2	1	1	2			3	2	2		3	3	3	
CO3	3	2	1	1	2			3	2	2		3	3	3	
CO4	3	3	2	1	1	2			3	2	2		3	3	
CO5	3	3	2	1	1	2			3	2	2		3	3	
CO6	3	3	2	1	1	2			3	2	2		3	3	
CO7	3	3	2	1	1	2			3	2	2		3	3	
CO8	3	3	2	1	1	2			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	10		40		50								100		
CAT2	10		25		65								100		
CAT3	10		30		60								100		
ESE	10		25		65								100		
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)															



20ECH01 - VLSI TECHNOLOGY								
Programme & Branch	B.E. & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit	
Prerequisites	Semiconductor Physics	5/6/7	HN	3	0	0	3	
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.								
								Total:45
TEXT BOOK:								
1.	Simon Sze, Ming-Kwei Lee “Semiconductor Devices Physics and Technology” 3 <sup>rd</sup> Edition, Wiley, 2012.							
REFERENCES:								
1.	Sze S.M “VLSI Technology” , 2 <sup>nd</sup> , McGraw-Hill New York, 2017.							
2.	Amar Mukherjee Introduction to NMOS and CMOS VLSI System Design, Ist, Prentice Hall India, New Delhi, 2000.							
3.	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)														





20ECH02 - VLSI SIGNAL PROCESSING							
Programme & Branch	B.E. & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	VLSI design	5/6/7	HN	3	1	0	4
Preamble	To apply the concepts of VLSI techniques to real time signal processing						
Unit – I	Introduction to DSP Systems:						9
Introduction To DSP Systems –Typical DSP algorithms; Iteration Bound – data flow graph representations, loop bound and iteration bound, Algorithms For Computing Iteration Bound, Iteration Bound of Multirate Data Flow Graphs. Pipelining and parallel processing: Pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power.							
Unit – II	Retiming & Unfolding:						9
Retiming : Definitions and properties Retiming techniques; Solving systems of inequalities, Retiming Techniques. Unfolding: Algorithm for Unfolding, properties of unfolding, Critical path Unfolding and Retiming applications of Unfolding-sample period reduction and parallel processing application							
Unit – III	Systolic Architecture Design & Bit Level Arithmetic Architectures:						9
Systolic Architecture Design: Design methodology, FIR systolic arrays Bit Level Arithmetic Architectures: Parallel Multipliers, Bit-Serial Multipliers, Bit-Serial Filter Design and Implementation, Canonic Signed Digit Arithmetic, Distributed Arithmetic.							
Unit – IV	Fast Convolution & Algorithmic strength reduction						9
Fast Convolution: Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm – Winograd Algorithm, Modified Winograd Algorithm. Algorithmic strength reduction: Algorithmic strength reduction in Filters-Parallel FIR Filters, DCT and Inverse DCT. Pipelined and Parallel Recursive filters							
Unit – V	Scaling, Round off Noise, Lattice Structure & Numerical Strength Reduction						9
Scaling, Round off Noise: Scaling and Round off Noise- State variable Description of digital filters, Scaling and round off noise computation, Round off noise in pipelined I order IIR filters. Lattice Structure: Introduction, Schur algorithm, Digital basic Lattice Filters, Derivation of One-Multiplier Lattice Filter, Derivation of Normalized Lattice filter. Numerical Strength Reduction-Introduction, Sub expression Elimination, Multiple Constant Multiplication, Sub expression Sharing in Digital Filters, Additive and Multiplicative Number Splitting.							
Lecture:45, Tutorial:15, Total:60							
TEXT BOOK:							
1.	Keshab K. Parhi, VLSI Digital Signal Processing Systems, Design and Implementation, Student Edition, John Wiley, Inter Science, New York, 2012, for Unit I to V.						
REFERENCES/ MANUAL / SOFTWARE:							
1.	Magdy A. Bayoumi, Earl E. Swartzlander, VLSI Signal Processing Technology, Springer US Publishers. 2012.						
2.	Mohammed Ismail, Terri Fiez, Analog VLSI Signal and Information Processing, McGraw-Hill, New York, 1994.						



COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	apply pipelining and parallel processing concepts for efficient low power architecture.												Applying (K3)	
CO2	apply retiming and unfolding techniques for the design of VLSI architecture.												Applying (K3)	
CO3	apply systolic and bit level architectures to improve the efficiency of VLSI circuits.												Applying (K3)	
CO4	apply fast convolution algorithms for FIR and IIR filters												Applying (K3)	
CO5	use of proper techniques for parallel processing design for scaling and roundoff noise computation												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	3								2	2	2
CO2	3	2	3	3								2	2	2
CO3	3	2	3	3								2	2	2
CO4	3	2	3	3								2	2	2
CO5	3	2	3	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		5		15		80								100
CAT2		5		15		80								100
CAT3		5		15		80								100
ESE		5		15		80								100
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)														



20ECH03 - SEMICONDUCTOR DEVICE MODELING								
Programme& Branch	B.E. & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit	
Prerequisites	Semiconductor Physics	5/6/7	HN	3	0	0	3	
Preamble	To understand the solid state devices characteristics and modeling.							
Unit – I	Modeling of Passive Devices:						9	
Quantum Mechanical Concepts- Carrier Concentration- Transport phenomena- Mobility and Resistivity- Carrier diffusion- Carrier Generation and Recombination- Continuity equation- Tunneling and High field effects-Modeling of resistors-Modeling of Capacitors-Modeling of Inductors.								
Unit – II	Diode and BJT Modeling:						9	
Abrupt and linear graded PN junction- Ideal diode current equation- Static, Small signal and Large signal models of PN junction Diode-Spice model for a Diode- Temperature and Area effects on Diode Model Parameters Transistor Action-Terminal currents -Switching- Static, Small signal and Large signal Eber-Moll models of BJT- temperature and area effects.								
Unit – III	MOS transistor Modeling and Parameter Measurements:						9	
MOSFET Fundamentals – Basic Characteristics -Subthreshold region – Types of MOSFET – Threshold Voltage control – MOSFET Scaling - Short channel effects -Models for MOSFET- FinFET-CNTFET.								
Unit – IV	Noise Models and BSIM4 MOSFET Model:						9	
Noise Sources in MOSFET-Flicker Noise Modeling-Thermal Noise Modeling- BSIM4 MOSFET Model-Gate Dielectric Model-Enhanced Models for Effective DC and AC Channel Length and width-Threshold Voltage Model-I-V Model.								
Unit – V	Other MOSFET Models:						9	
EKV Model-Model Features-Long Channel Drain Current Model-Modeling Second order Effects of Drain Current-Effect of Charge Sharing-Modeling of Charge storage Effects-Non-quasi static Modeling-Noise Models-Temperature Effects-MOS Model 9-MOSAI Model								
Total:45								
TEXT BOOK:								
1.	Massobrio Giuseppe and Antognetti Paolo, “Semiconductor Device Modeling with SPICE”, Second Edition, McGraw-Hill Inc, New York, 2010							
REFERENCES:								
1.	Sze S. M., “Semiconductor Devices-Physics and Technology”, 3 <sup>rd</sup> Edition, John Wiley and Sons, New York, 2010.							
2.	TrondYtterdal, Yuhua Cheng and Tor A.Fjeldly,, ”Device Modeling for Analog and RF CMOS Circuit Design”John Wiley &Sons Ltd ,2003.							



COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	realize the concepts of semiconductor physics											Understanding(K2)		
CO2	understand various mathematical concepts to model semiconductor devices											Understanding(K2)		
CO3	apply mathematical concepts to model MOSFET											Applying(K3)		
CO4	appreciate the effects of noise in MOSFET using mathematical concepts.											Understanding(K2)		
CO5	comprehend the secondary effects of semiconductor physics using mathematical expressions											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	1			1				1	1	2	
CO2	2	1	2	1	2							1	1	
CO3	2	2	2	2	2							1	2	
CO4	2	3	2	3	2		1						2	
CO5	1		2	3	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		80		-		-		-		-		100
CAT2		20		70		10		-		-		-		100
CAT3		20		65		15		-		-		-		100
ESE		20		65		15		-		-		-		100
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)														



20ECJ02 - MIXED SIGNAL IC DESIGN								
Programme & Branch	B.E. & Electronics and Communication Engineering	Sem.	Category	L	T	P	Credit	
Prerequisites	VLSI design	5/6/7	HN	3	0	2	4	
Preamble	To build the advanced CMOS VLSI Design with practical aspect of mixed signal VLSI blocks such as data converters							
Unit – I	Signals and Filters:						9	
Sinusoidal Signals- Comb Filters- Representing Signals- Sampling- Decimation- The Sample-and-Hold- The Track-and-Hold- Interpolation- Implementing the S/H- The Discrete Analog Integrator (DAI).								
Unit – II	Analog filters:						9	
Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, gm- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.								
Unit – III	Data Converter Architectures:						9	
DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.								
Unit – IV	Data Converter Modeling And SNR:						9	
Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.								
Unit – V	Oscillators And PLL:						9	
LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.								
LIST OF EXPERIMENTS / EXERCISES:								
1.	Design sample and hold circuit for sampling analog signal							
2.	Design and analyse the characteristics of integrator and decimator							
3.	Design and analyse the characteristics of COMB filters							
4.	Design and analyse the performance of Analog to Digital Converter using successive approximation.							
5.	Design and analyse the performance of Analog to Digital Converter using ladder networks.							
6.	Design and analyse the performance of Digital to Analog Converter using pipelining							
7.	Design and analyse the decimating filter for ADC and interpolating filter for DAC.							
8.	Design and analyse the characteristics of LC oscillator							
9.	Design and analyse the characteristics of Voltage controlled oscillator							
10.	Design PLL and analyse the non-ideal effects.							
Lecture:45, Practical:30, Total:75								
TEXT BOOK:								
1.	R.Jacob Baker, “CMOS Mixed Signal Circuit Design” Wiley India, IEEE Press, reprint 2008, for Units I, II, III, IV.							
2.	Behzad Razavi, “ Design of Analog CMOS Integrated Circuits” McGraw Hill, 33 <sup>rd</sup> Re- print, 2016, for Units V.							
REFERENCES/ MANUAL / SOFTWARE:								
1.	R.Jacob Baker, “CMOS Circuit Design, Layout and Simulation”, Wiley India, IEEE Press, Second Edition, reprint 2009.							
2.	David A. Johns and Ken Martin, Analog Integrated Circuit Design, John Wiley and Sons, 1997.							



COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	infer the concepts for mixed signal MOS circuit.												Understanding (K2)		
CO2	understand the characteristics of IC based CMOS filters.												Understanding (K2)		
CO3	design various data converter architecture circuits.												Analysing (K4)		
CO4	comprehend the signal to noise ratio and modelling of mixed signals.												Applying (K3)		
CO5	Illustrate the operation of oscillators and phase lock loop circuit.												Analysing (K4)		
CO6	design and analyse the characteristics of integrator and analog filters												Analysing (K4)/ Precision (S3)		
CO7	design and analyse the characteristics of various data converter architecture circuits												Analysing (K4)/ Precision (S3)		
CO8	design and analyse the characteristics of oscillators and phase lock loop circuit.												Analysing (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	2	1												
CO2	3	2	1	1	2			3	2	2		3	3	3	
CO3	3	2	1	1	2			3	2	2		3	3	3	
CO4	3	2	1												
CO5	3	2	1	1	2			3	2	2		3	3	3	
CO6	3	2	1	1	2			3	2	2		3	3	3	
CO7	3	2	1	1	2			3	2	2		3	3	3	
CO8	3	2	1	1	2			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		20		80										100	
CAT2		10		70		20								100	
CAT3		10		70		20								100	
ESE		10		70		20								100	
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)															