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 INSTRUMENTATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

INDEX

KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 060
(Autonomous)

INSTITUTE VISION

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

INSTITUTE MISSION

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

QUALITY POLICY

We are committed to

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

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING	
VISION	
To become a technically competent centre in the domain of Electronics and Instrumentation Engineering to take care of the national and international needs.	
MISSION	
Department of Electronics and Instrumentation Engineering is committed to:	
MS1:	To develop innovative, competent, efficient, disciplined and quality Electronics and Instrumentation Engineers.
MS2:	To produce engineers who can participate in technical advancement and social upliftment of the country.
MS3:	To excel in academic and research activities by facilitating the students to explore the state- of – the –art techniques to meet the industrial needs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Electronics and Instrumentation Engineering will

PEO1:	Excel in professional career and higher education using their fundamental knowledge in mathematical and engineering principles
PEO2:	Analyse, design, develop and maintain the instrumentation systems of an industry and also offer solutions that are technically feasible, economically viable and socially relevant.
PEO3:	Exhibit Professional and Ethical code of conduct, communication skills, team work and lifelong learning to resolve societal issues

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	2	1
MS2	2	3	2
MS3	1	3	3

1 – Slight, 2 – Moderate,3 – Substantial

PROGRAM OUTCOMES (POs)

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

PSO1 **Development and Automation:** Develop an industrial instrumentation system and provide automation by using modern automation tools.

PSO2 **Entrepreneurship:** Become an entrepreneur by inculcating the skills of project management and finance with the knowledge of instrumentation technology.

MAPPING OF PEOs WITH POs AND PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(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 Augumented Reality	BE- Computer Science and Design
21.	Data Science	BE- Computer Science and Design
22.	Internet of Things (IoT)	BTech – Artificial Intelligence and Data Science
23.	Blockchain	BTech – Artificial Intelligence and Data Science
24.	Internet of Things (IoT)	BTech – Artificial Intelligence and Machine Learning
25.	Blockchain	BTech – Artificial Intelligence and Machine Learning

*Title by KEC

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

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project work, internship, professional skills training/industrial training, comprehensive test & viva, internship and entrepreneurships/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:

<table>
<tr><th>Sl. No.</th><th>Category of Course</th><th>Continuous Assessment Marks</th><th>End Semester Examination Marks</th></tr>
<tr><td>1.</td><td>Theory / Practical</td><td>50</td><td>50</td></tr>
<tr><td>2.</td><td>Theory cum Practical</td><td colspan="2">The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.</td></tr>
<tr><td>3.</td><td>Professional Skills Training / / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work - I / Industrial Training / Mandatory Course</td><td>100</td><td>---</td></tr>
<tr><td>4.</td><td>Project Work-II Phase-I / Project Work-II Phase-II / Internships</td><td>50</td><td>50</td></tr>
<tr><td>5.</td><td>Value Added Course</td><td rowspan="2">The distribution of marks shall be decided based on the credit weightage assigned</td><td rowspan="2">---</td></tr>
<tr><td>6.</td><td>All other Courses</td></tr>
</table>

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

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 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:

<table>
<tr><th>Sl. No.</th><th>Type</th><th>Max. Marks</th><th>Remarks</th></tr>
<tr><td rowspan="3">1.</td><td>Test - I</td><td>30</td><td rowspan="3">Average of best two</td></tr>
<tr><td>Test - II</td><td>30</td></tr>
<tr><td>Test - III</td><td>30</td></tr>
<tr><td>2.</td><td>Tutorial</td><td>15</td><td>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)</td></tr>
<tr><td>3.</td><td>Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes</td><td>05</td><td>To be assessed by the Course Teacher based on any one type.</td></tr>
<tr><td colspan="2" align="right">Total</td><td>50</td><td>Rounded off to the one decimal place</td></tr>
</table>

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 Committee	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 4th semester vacation and during 5th semester. Phase-II training shall be conducted for minimum of 80 hours in 5th semester vacation and during 6th 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 entrepreneurships/ start ups activities, but has secured not less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

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

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

8.1.5 Candidate's progress is satisfactory.

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

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

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

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

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

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

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

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

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

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

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

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

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

11. PROVISION FOR BREAK OF STUDY

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

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

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

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

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

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

12. PASSING REQUIREMENTS

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

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

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

13. REVALUATION OF ANSWER SCRIPTS

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

14. SUPPLEMENTARY EXAMINATION

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

15. AWARD OF LETTER GRADES

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

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

ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate’s programme within the stipulated time (vide clause 5).

iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-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	07.69
BS	11	11	4	4					30	17.75
ES	4	4/8	4	8/4					20	11.83
PC	4	3/0	12/11	8/12	13	13	3		56	33.13
PE					3		12	3	18	10.65
OE				4	4	3		3	14	08.28
EC					2	6	6	4	18	10.65
MC										
Semester wise Total	22	22/23	23/22	24	22	22	24	10	169	100.00

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

CATEGORISATION OF COURSES

HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	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 Work Place 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
		Total Credits to be earned				13	

BASIC SCIENCE (BS)

S. No.	Course Code	Course Name	L	T	P	C	Sem

1.	20MAC11	Matrices and Differential Equations	3	0	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.	20PHT24	Materials Science and Solid state Devices	3	0	0	3	II
7.	20CYT23	Chemistry for Electronic Materials	3	0	0	3	II
8.	20PHL26	Physical Sciences Laboratory II	0	0	2	1	II
9.	20MAT32	Probability, Transforms and Partial Differential Equations	3	1	0	4	III
10.	20MAT41	Statistics and Numerical Methods	3	1	0	4	IV
		Total Credits to be earned				**30**	

ENGINEERING SCIENCE (ES)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20EIT11	Electron Devices and Circuits	3	0	0	3	I
2.	20EIL11	Circuits and Devices 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	II/III
6.	20CSC41	Python Programming	3	0	2	4	III/IV
7.	20EIT42	Digital Logic Circuits	3	1	0	4	IV
		Total Credits to be earned				**20**	

EMPLOYABILITY ENHANCEMENT COURSES (EC)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20GEL51/ 20GEI51	Professional Skills Training I / Industrial Training I	-	-	-	2	V
2.	20EIP61	Project Work I	0	0	6	2	VI
3.	20GEL61 /20GEI61	Professional Skills Training II / Industrial Training II	---	---	---	2	VI
4.	20EIP71	Project Work I Phase I	0	0	12	6	VII
5.	20GEL71	Comprehensive Test / Viva	-	-	-	2	VII
6.	20EIP81	Project Work II Phase II	---	---	8	4	VIII
		Total Credits to be earned				**18**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	20EIT12	Circuit Theory	3	1	0	4	I	EL
2.	20EIT21	Transducers Engineering	3	0	0	3	II/III	IN
3.	20EIT31	Networks, Signals and Systems	3	1	0	4	III/IV	IN
4.	20EIT32	Analog Integrated Circuits	3	0	0	3	III	EL
5.	20EIT33	Electrical Measurements and Instrumentation	3	0	0	3	III	EL
6.	20EIL31	Transducers and Measurements Laboratory	0	0	2	1	III	EL
7.	20EIL32	Analog Integrated Circuits Laboratory	0	0	2	1	III	EL
8.	20EIT41	Industrial Instrumentation-I	3	0	0	3	IV	IN
9.	20EIT43	Electrical Machines and Drives	3	0	0	3	IV	EL
10.	20EIL41	Instrumentation System Design Laboratory	0	0	2	1	IV	IN
11	20EIL42	Virtual Instrumentation Laboratory	0	0	2	1	IV	IN
12.	20EIT51	Control Systems	3	1	0	4	V	IN
13.	20EIT52	Microprocessor and Microcontroller	3	0	0	3	V	EL
14.	20EIT53	Industrial Instrumentation – II	3	0	0	3	V	IN
15.	20EIL51	Electrical Machines and Control Laboratory	0	0	2	1	V	IN
17.	20EIL52	Microcontroller and Interfacing Laboratory	0	0	2	1	V	EL
18.	20EIL53	Industrial Instrumentation Laboratory	0	0	2	1	V	IN
19.	20EIT61	Process Control	3	0	0	3	VI	IN
20.	20EIT62	Digital Signal Processing	3	1	0	4	VI	EL
21.	20EIT63	Logic and Distributed Control Systems	3	0	0	3	VI	IN
22.	20EIL61	Process Control Laboratory	0	0	2	1	V	IN
23.	20EIL62	Signal Processing and Embedded Systems Laboratory	0	0	2	1	VI	EL
24	20EIL63	Logic and Distributed Control Systems Laboratory	0	0	2	1	VI	IN
25.	20EIT71	Industrial Data Communication	3	0	0	3	VII	IN
Total Credits to be earned						**56**		

PROFESSIONAL ELECTIVE (PE)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
		Elective - I						

1.	20EIE01	Biomedical Instrumentation	3	0	0	3	V	AI
2.	20EIE02	Embedded Systems	3	0	0	3	V	AE
3.	20EIE03	Soft Computing Techniques	3	0	0	3	V	EEA
4.	20EIE04	Piping and Instrumentation Diagrams	3	0	0	3	V	IA
5.	20EIE05	Industrial Electronics and Drives	3	0	0	3	V	CS
6.	20EIE06	Advanced Control Theory	3	0	0	3	V	CS
		Elective - II						
7.	20EIE07	Analytical Instrumentation	3	0	0	3	VII	AI
8.	20EIE08	Instrumentation System Design	3	0	0	3	VII	AI
9.	20EIE09	Digital Image Processing	3	0	0	3	VII	EEA
10.	20EIE10	Power Plant Instrumentation	3	0	0	3	VII	IA
11.	20EIE11	Wireless Instrumentation	3	0	0	3	VII	AE
12.	20EIE12	Advanced PID Control	3	0	0	3	VII	CS
13.	20GEE01	Fundamentals of Research	3	0	0	3	VII	GE
		Elective - III						
14.	20EIE13	Fiber Optics and Laser Instruments	3	0	0	3	VII	AI
15.	20EIE14	Wearable Technology	3	0	0	3	VII	AE
16.	20EIE15	Deep Neural Networks for Computational Imaging	3	0	0	3	VII	EEA
17.	20EIE16	Instrumentation Techniques in Agriculture	3	0	0	3	VII	IA
18.	20EIE17	Industrial Internet of Things	3	0	0	3	VII	AE
19.	20EIE18	Optimal and Adaptive Control	3	0	0	3	VII	CS
20.	20EIE19	Total Quality Management	3	0	0	3	VII	GE
		Elective - IV						
21.	20EIE20	Safety in Process Industries	3	0	0	3	VII	AI
22.	20EIE21	VLSI Systems	3	0	0	3	VII	AE
23.	20EIE22	MEMS and Nano Technology	3	0	0	3	VII	AE
24.	20EIE23	Instrumentation in Aircraft Navigation and Control	3	0	0	3	VII	IA
25.	20EIE24	Machine Learning and Its Applications	3	0	0	3	VII	EEA
26.	20EIE25	Control System Components	3	0	0	3	VII	CS
		Elective - V						
27.	20EIE26	Multi Sensor Data Fusion	3	0	0	3	VII	EEA
28.	20EIE27	Electronic Instrumentation	3	0	0	3	VII	AI

29.	20EIE28	Artificial Intelligence	3	0	0	3	VII	EEA
30.	20EIE29	Instrumentation and Control in Process Industries	3	0	0	3	VII	IA
31.	20EIE30	Intelligent Robotic Systems	3	0	0	3	VII	AI
32.	20EIE31	Computer Control of Processes	3	0	0	3	VII	CS
		Elective - VI						
34.	20EIE32	Diagnostic and Therapeutic Instruments	3	0	0	3	VIII	AI
35.	20EIE33	3D Printing Hardware	3	0	0	3	VIII	AE
36.	20EIE34	Neuroimaging for Data Analysis	3	0	0	3	VIII	EEA
37.	20EIE35	Instrumentation and Control in Petro Chemical Industries	3	0	0	3	VIII	IA
38	20EIE36	VHDL Programming and Its Applications	3	0	0	3	VIII	AE
39.	20EIE37	Model Predictive Control	3	0	0	3	VIII	CS
Total Credits to be earned						**18**		

***** Domain/Stream Abbreviations: IN-Instrumentation, EL-Electronics, AI-Applied Instrumentation, AE-Applied Electronics and Industry 4.0, EEA-Experimental Engineering and Analysis, IA-Industry Automation, CS-Control Systems, GE – General Engineering.

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20EIO01	Digital Image Processing and Its Applications	3	1	0	4	IV
2.	20EIO02	Industrial Automation	3	1	0	4	V
3.	20EIO03	Measurements and Instrumentation	3	1	0	4	V
4.	20EIO04	Biomedical Instrumentation and Applications	3	0	0	3	VI
5.	20EIO05	PLC Programming and Its Applications	3	0	0	3	VI
6.	20EIO06	Instrumentation for Industry 4.0	3	0	0	3	VI
7.	20EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	VIII
8.	20EIO08	Testing of Materials	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.
		SEMESTER - IV					
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
5	20ECO01	Wearable Technology	3	1	0	4	ECE
6	20ECO02	Basics of Electronics in Automation Appliances	3	1	0	4	ECE
7	20ECO03	Principles of Quantum Computing	3	0	2	4	ECE
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	20CSO01	Fundamentals of Databases	3	0	2	4	CSE
12	20CSO02	Python Programming and Frameworks	3	0	2	4	CSE
13	20ITO01	Artificial Intelligence	3	1	0	4	IT
14	20ITO02	Web Technologies	3	1	0	4	IT
15	20ITO03	Introduction to Operating Systems	3	1	0	4	IT
16	20ITO04	Programming in Python	3	1	0	4	IT
17	20CHO01	Drugs and Pharmaceuticals Technology	3	1	0	4	CHEM
18	20CHO02	Process Automation	3	1	0	4	CHEM
19	20FTO01	Baking Technology	3	0	2	4	FT
20	20FTO02	Food Processing Technology	3	1	0	4	FT
21	20CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD
22	20ADO01	Data Warehousing and Data Mining	3	0	2	4	AIDS
23	20ALO01	Business Intelligence	3	1	0	4	AIML
24	20PHO01	Thin Film Technology	3	1	0	4	PHY
25	20CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMIS
		SEMESTER - V					
26	20CEO02	Disaster Management	3	1	0	4	CIVIL
27	20MEO02	Design of Experiments	3	0	2	4	MECH
28	20MTO02	Factory Automation	3	0	2	4	MTS
29	20MTO03	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
30	20AUO02	Automotive Electronics	3	0	2	4	AUTO
31	20ECO04	PCB Design and Fabrication	3	0	2	4	ECE
32	20EEO04	Energy Conservation and Management	3	1	0	4	EEE
33	20CSO03	Computational Science for Engineers	3	1	0	4	CSE

34	20CSO04	Formal Languages and Automata	3	1	0	4	CSE
35	20ITO05	Data Science	3	1	0	4	IT
36	20ITO06	Advanced Java Programming	3	1	0	4	IT
37	20CHO03	Renewable Bioenergy Resources	3	1	0	4	CHEM
38	20CHO04	Intelligent Controllers	3	1	0	4	CHEM
39	20FTO03	Processing of Milk and Milk Products	3	0	2	4	FT
40	20FTO04	Processing of Fruits and Vegetables	3	0	2	4	FT
41	20CDO02	Fundamentals of User Interactive Design	3	0	2	4	CSD
42	20ADO02	Computer Vision	3	0	2	4	AIDS
43	20ALO02	Data Exploration and Visualization Techniques	3	0	2	4	AIML
44	20PHO02	High Energy Storage Devices	3	0	0	3	PHY
45	20CYO02	Corrosion Science and Engineering	3	1	0	4	CHEMIS
46	20CYO03	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMIS
47	20CYO04	Chemistry of Nutrition for Women Health	3	1	0	4	CHEMIS
48	20MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
49	20MAO02	Graph Theory and its Applications	3	1	0	4	MATHS
		SEMESTER - VI					
50	20CEO03	Introduction to Smart Cities	3	0	0	3	CIVIL
51	20CEO04	Environmental Health and Safety	3	0	0	3	CIVIL
52	20MEO03	Fundamentals of Ergonomics	3	0	0	3	MECH
53	20MEO04	Principles of Management and Industrial Psychology	3	0	0	3	MECH
54	20MTO04	3D Printing and Design	3	0	0	3	MTS
55	20MTO05	Drone System Technology	3	0	0	3	MTS
56	20MTO06	Virtual and Augument Reality in Industry 4.0	3	0	0	3	MTS
57	20AUO03	Vehicle Maintenance	3	0	0	3	AUTO
58	20ECO05	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
59	20ECO06	Bioinspired Computing Technologies	2	0	2	3	ECE
60	20EEO05	Micro Grid and Smart Grid	3	0	0	3	EEE
61	20EEO06	E-Waste Management	3	0	0	3	EEE
62	20CSO05	Java Programming	2	0	2	3	CSE
63	20CSO06	Web Engineering	2	0	2	3	CSE
64	20CSO07	Nature Inspired Optimization Techniques	3	0	0	3	CSE
65	20ITO07	Bio Natural Language Processing	3	0	0	3	IT
66	20ITO08	Disaster Management for Information Technology	3	0	0	3	IT
67	20CHO05	Food as Medicine	3	0	0	3	CHEM
68	20CHO06	Organic Farming	3	0	0	3	CHEM
69	20FTO05	Principles of Food Safety	3	0	0	3	FT
70	20FTO06	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
71	20CDO03	Introduction to Mobile Game Design	3	0	0	3	CSD
72	20ADO03	Neural Networks and Deep Learning	3	0	0	3	AIDS

73	20ALO03	Industrial Machine Learning	3	0	0	3	AIML
74	20PHO03	Structural and Optical Characterization of Materials	3	0	0	3	PHY
75	20CYO05	Chemistry Concepts for Competitive Examinations	3	0	0	3	CHEMIS
76	20CYO06	Waste and Hazardous Waste Management	3	0	0	3	CHEMIS
77	20MAO03	Data Analytics using R Programming	3	0	2	4	MATHS
78	20MAO04	Number Theory and Cryptography	3	1	0	4	MATHS
		SEMESTER - VIII					
79	20CEO05	Infrastructure Planning and Management	3	0	0	3	CIVIL
80	20CEO06	Environmental Laws and Policy	3	0	0	3	CIVIL
81	20MEO05	Safety Measures for Engineers	3	0	0	3	MECH
82	20MEO06	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
83	20MTO06	Robotics	3	0	0	3	MTS
84	20AUO04	Public Transport Management	3	0	0	3	AUTO
85	20AUO05	Autonomous Vehicles	3	0	0	3	AUTO
86	20ECO07	Optical Engineering	3	0	0	3	ECE
87	20EEO07	Electric Vehicle	3	0	0	3	EEE
88	20CSO08	Fundamentals of Internet of Things	3	0	0	3	CSE
89	20CSO09	Machine Translation	3	0	0	3	CSE
90	20CSO10	Fundamentals of Blockchain	3	0	0	3	CSE
91	20ITO09	Modern Application Development	3	0	0	3	IT
92	20ITO10	Object Oriented System Development using UML	3	0	0	3	IT
93	20ITO11	Reinforcement Learning	3	0	0	3	IT
94	20CHO07	Cosmetics and Personal Health Care Products	3	0	0	3	CHEM
95	20CHO08	Brewing and Alcohol Technology	3	0	0	3	CHEM
96	20FTO07	Food Ingredients	3	0	0	3	FT
97	20FTO08	Food and Nutrition	3	0	0	3	FT
98	20CDO04	Introduction to Graphics Design	3	0	0	3	CSD
99	20ADO04	Business Analytics	3	0	0	3	AIDS
100	20ALO04	Machine Learning for Smart Cities	3	0	0	3	AIML
101	20MAO05	Advanced Linear Algebra	3	0	0	3	MATHS
102	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	Semester	Offering Dept.
1	20GEO01	German Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
2	20GEO02	Japanese Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
3	20GEO03	Design Thinking for Engineers	3	1	0	4	V	CSE
4	20GEO04	Innovation and Business Model Development	3	1	0	4	VI	MTS

5	20GEO05	German Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
6	20GEO06	German Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
7	20GEO07	German Language Level 4	3	0	0	3	IV/V/VII/VIII	ECE
8	20GEO08	Japanese Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
9	20GEO09	Japanese Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
10	20GEO10	Japanese Language Level 4	3	0	0	3	IV/V/VII/VIII	ECE
11	20GEO11	NCC Studies (Army Wing) - I	3	0	2	4	V/VI	EEE
12	20GEO12	NCC Studies (Air Wing) - I	3	0	2	4	V/VI	IT
13	20GEO13	French Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
14	20GEO14	French Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
15	20GEO15	French Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
16	20GEO16	Spanish Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
17	20GEO17	Spanish Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
18	20GEO18	Spanish Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
19	20GEO19	Entrepreneurship Development	3	0	0	3	VIII	MTS

KEC R2020: SCHEDULING OF COURSES – B.E.(Electronics and Instrumentation Engineering) Total Credits: 169

Sem	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	20GET11-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)	20EIT11-Electron Devices and circuits (3-0-0-3)	20EIT12-Circuit Theory (3-1-0-4)	20EIL11-Circuits and Devices Laboratory (0-0-2-1)	20PHL11-Physical Sciences lab I (0-0-2-1)	20MNT11-Induction Training Programme		22
II	20EGT21-Advanced Communication Skills (3-0-0-3)	20MAC21-Multivariable Calculus and Complex Analysis (3-1-2-4)	20PHT24-Materials Science and solid state devices (3-0-0-3)	20CYT23-Chemistry for Electronic material (3-0-0-3)	20EIT21-Transducers Engineering* (3-0-0-3) 20CSC31-Programming in C# (3-0-2-4)	20MEC11-Engineering Drawing (2-0-2-3)	20MEL11-Engineering Practices Lab (0-0-2-1)	20PHL26-Physical Sciences lab II (0-0-2-1)	20VEC11-Yoga and Values for Holistic Development (0-0-0-1)		22/23
III	20CSC31-Programming in C (3-0-2-4) 20CSC41-Python Programming# (3-0-2-4)	20MAT32-Probability, Transforms and Partial Differential Equations (3-1-0-4)	20EIT31-Networks, Signals and Systems (3-1-0-4) 20EIT21-Transducers Engineering* (3-0-0-3)	20EIT32-Analog Integrated circuits (3-0-0-3)	20EIT33-Electrical Measurements and Instrumentation (3-0-0-3)	20EIL32-Analog Integrated Circuits Laboratory (0-0-2-1)	20EIL31-Transducers and Measurements Laboratory (0-0-2-1)	20EGL31-English for work place Communication Laboratory (0-0-2-1)	20GET31-Universal Human Values (2-0-0-2)		23/22
IV	20CSC41-Python Programming (3-0-2-4) 20EIT31-Networks, Signals and Systems (3-1-0-4)	20MAT41-Statistics and Numerical Methods (3-1-0-4)	20EIT41-Industrial Instrumentation I (3-0-0-3) 20EIT42-Control Systems (3-1-0-4)	20EIT42-Digital Logic Circuits (3-1-0-4)	20EIT43-Electrical machines and Drives (3-0-0-3)	Open Elective – 1 (3-1-0-4)/ (3-0-2-4)	20EIL41-Instrumentation System design laboratory (0-0-2-1)	20EIL42-Virtual Instrumentation Laboratory (0-0-2-1)	20MNT31-Environmental Science (2-0-0-0)		24
V	20EIT51-Control System (3-1-0-4)	20EIT52-Microprocessor and Microcontroller (3-0-0-3)	20EIT53-Industrial Instrumentation II (3-0-0-3)	Professional Elective-1 (3-0-0-3)	Open Elective – 2 (3-1-0-4)/ (3-0-2-4)	20EIL51-Electrical Machines and Control Laboratory (0-0-2-1)	20EIL52-Microcontroller and Interfacing Laboratory (0-0-2-1)	20EIL53-Industrial Instrumentation Laboratory (0-0-2-1)	20GEL51-Professional Skills I / Industrial Training I (0-0-0-2)		**22**
VI	20EIT61-Process Control (3-1-0-4)	20EIT62-Digital Signal Processing (3-1-0-4)	20EIT63- Logic and Distributed Control Systems (3-0-0-3)	Open Elective – 3 (3-0-0-3)	20EIL61 – Process Control Laboratory (0-0-2-1)	20EIL62-Signal Processing and Embedded Systems Laboratory (0-0-2-1)	20EIL63-Logic and Distributed Control Systems Laboratory (0-0-2-1)	20EIP61-Project Work I Phase I (0-0-4-2)	20GEL61-Professional Skills Training/ 20GEI61-Ind. Training (0-0-0-2)	20GEP61-Comprehensive Test and Viva- (0-0-0-2)	22
VII	20GET71-Engineering Economics & Management (3-0-0-3)	20EIT71-Industrial Data Communication (3-0-0-3)	Professional Elective – 2 (3-0-0-3)	Professional Elective – 3 (3-0-0-3)	Professional Elective – 4 (3-0-0-3)	Professional Elective – 5 (3-0-0-3)	20EIP72-Project work-II phase-I (0-0-12-6)				21
VIII	Open Elective – 4 (3-0-0-3)	Professional Elective -6 (3-0-0-3)	20EIP81 Project work II Phase II (0-0-8-4)								**13**

MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	20GET11	English Language Skills						✓			✓	✓	✓	✓		
1	20MAC11	Matrices and Differential Equations	✓	✓	✓	✓	✓									
1	20PHT11	Applied Physics	✓	✓	✓											
1	20CYT11	Applied Chemistry	✓	✓	✓	✓										
1	20EIT11	Electron Devices and Circuits	✓	✓	✓	✓	✓								✓	✓
1	20EIT12	Circuit Theory	✓	✓	✓	✓	✓								✓	✓
1	20EEL11	Circuits and Devices Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
1	20PHL11	Physical Sciences Laboratory I				✓										
2	20VEC11	Yoga and Values for Holistic Development						✓		✓	✓			✓		
2	20EGT21	Advanced Communication Skills						✓			✓	✓	✓	✓		
2	20MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	20PHT24	Materials Science and Solid State Devices	✓	✓	✓											
2	20CYT23	Chemistry for Electronic Materials	✓	✓	✓	✓										
2/3	20EIT21	Transducers Engineering	✓	✓	✓	✓	✓			✓				✓	✓	✓
2	20MEC11	Engineering Drawing	✓	✓	✓	✓						✓	✓	✓	✓	✓
2	20MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓	✓		✓	✓		✓		
2	20PHL26	Physical Sciences Laboratory II			✓											
2/3	20CSC31	Programming in C	✓	✓	✓	✓	✓				✓	✓		✓		
3	20MAT32	Probability, Transforms and Partial Differential Equations	✓	✓	✓											
3	20EIT31	Networks, Signals and Systems	✓	✓	✓	✓	✓								✓	✓
3	20EIT32	Analog Integrated Circuits	✓	✓	✓	✓	✓								✓	✓
3	20EIT33	Electrical Measurements and Instrumentation	✓	✓	✓	✓	✓								✓	✓
3	20EGL31	English for Work Place Communication Laboratory									✓	✓		✓	✓	✓
3	20EIL31	Transducers and Measurements Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	20EIL32	Analog Integrated Circuits Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	20GET31	Universal Human values						✓	✓	✓	✓	✓				

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3/4	20CSC41	Python Programming	✓	✓	✓	✓										
4	20MAT41	Statistics and Numerical Methods	✓	✓	✓	✓										
4	20EIT41	Industrial Instrumentation – I	✓	✓	✓	✓	✓			✓				✓	✓	✓
4	20EIT42	Digital Logic Circuits	✓	✓	✓	✓	✓								✓	✓
4	20EIT43	Electrical Machines and Drives	✓	✓	✓	✓	✓								✓	✓
4	20EIL41	Instrumentation System Design Lab	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓
4	20EIL42	Virtual Instrumentation Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
4	20MNT31	Environmental Science	✓	✓	✓				✓							
5	20EIT51	Control Systems	✓	✓	✓	✓	✓			✓				✓	✓	✓
5	20EIT52	Microprocessor and Microcontrollers	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
5	20EIT53	Industrial Instrumentation – II	✓	✓	✓	✓	✓			✓				✓	✓	✓
5	20EIL51	Electrical Machines and Control laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	20EIL52	Microcontroller and Interfacing Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	20EIL53	Industrial Instrumentation Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓
5	20GEL51	Professional Skills Training 1 / Industrial Training 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	20EIT61	Process Control	✓	✓	✓	✓	✓			✓				✓	✓	✓
6	20EIT62	Digital Signal Processing	✓	✓	✓	✓	✓								✓	✓
6	20EIT63	Logic and Distributed Control Systems	✓	✓	✓	✓	✓			✓		✓			✓	✓
6	20EIL61	Process Control Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	20EIL62	Signal Processing and Embedded Systems Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	20EIL63	Logic and Distributed Control Systems Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	20EIP61	Project Work 1 Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	20GEP61	Comprehensive Test / Viva	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓
7	20GET71	Engineering Economics & Management	✓	✓	✓	✓	✓								✓	✓
7	20EIT71	Industrial Data Communication	✓	✓	✓	✓	✓	✓		✓					✓	✓
7	20EIP71	Project Work II Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	20EIP81	Project work II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Courses														
5	20EIE01	Biomedical Instrumentation	✓	✓	✓	✓	✓	✓		✓					✓	✓
5	20EIE02	Embedded Systems	✓	✓	✓	✓	✓			✓		✓			✓	✓
5	20EIE03	Soft Computing Techniques	✓	✓	✓	✓	✓								✓	✓
5	20EIE04	Piping and Instrumentation Diagrams	✓	✓	✓	✓	✓			✓		✓			✓	✓
5	20EIE05	Industrial Electronics and Drives	✓	✓	✓	✓	✓								✓	✓
5	20EIE06	Advanced Control theory	✓	✓	✓	✓	✓					✓			✓	✓
7	20EIE07	Analytical Instrumentation	✓	✓	✓	✓	✓	✓							✓	✓
7	20EIE08	Instrumentation System Design	✓	✓	✓	✓	✓								✓	✓
7	20EIE09	Digital Image Processing	✓	✓	✓	✓	✓			✓		✓			✓	✓
7	20EIE10	Power Plant Instrumentation	✓	✓	✓	✓	✓		✓			✓			✓	✓
7	20EIE11	Wireless Instrumentation	✓	✓				✓		✓					✓	✓
7	20EIE12	Advanced PID Control	✓	✓	✓	✓	✓			✓		✓			✓	✓
7	20EIE13	Fiber Optics and Laser Instruments	✓	✓	✓	✓	✓								✓	✓
7	20EIE14	Wearable Technology	✓	✓	✓	✓	✓	✓							✓	✓
7	20EIE15	Deep Neural Networks for Computational Imaging	✓	✓	✓	✓	✓								✓	✓
7	20EIE16	Instrumentation Techniques in Agriculture	✓	✓											✓	✓
7	20EIE17	Industrial Internet of Things	✓	✓	✓	✓	✓			✓					✓	✓
7	20EIE18	Optimal and Adaptive Control	✓	✓	✓	✓	✓								✓	✓
	20EIE19	Total Quality Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20EIE20	Safety in Process Industries	✓	✓	✓	✓	✓	✓		✓					✓	✓
7	20EIE21	VLSI Systems	✓	✓	✓	✓	✓								✓	✓
7	20EIE22	MEMS and Nano Technology	✓	✓	✓	✓	✓								✓	✓
7	20EIE23	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓								✓	✓
7	20EIE24	Machine Learning and its Applications	✓	✓	✓	✓	✓								✓	✓
7	20EIE25	Control System Components	✓	✓	✓	✓	✓					✓			✓	✓
7	20EIE26	Multi Sensor Data Fusion	✓	✓	✓	✓	✓								✓	✓

7	20EIE27	Electronic Instrumentation	✓	✓	✓	✓	✓			✓					✓	✓
7	20EIE28	Artificial Intelligence	✓	✓	✓	✓	✓								✓	✓
7	20EIE29	Instrumentation and Control in Process Industries	✓	✓	✓	✓	✓								✓	✓
7	20EIE30	Intelligent Robotic Systems	✓	✓	✓	✓	✓								✓	✓
7	20EIE31	Computer Control of Processes	✓	✓	✓	✓	✓								✓	✓
8	20EIE32	Diagnostic and Therauptic Instruments	✓	✓	✓	✓	✓	✓							✓	✓
8	20EIE33	3D Printing Hardware	✓	✓											✓	✓
8	20EIE34	Neuroimaging for Data Analysis	✓	✓	✓	✓	✓								✓	✓
8	20EIE35	Instrumentation and Control in Petro Chemical Industries	✓	✓	✓	✓	✓								✓	✓
8	20EIE36	VHDL Programming and Its Applications	✓	✓	✓	✓	✓						✓		✓	✓
8	20EIE37	Model Predictive Control	✓	✓	✓	✓	✓								✓	✓
		Open Elective Courses														
4	20EIO02	Digital Image Processing and Its Applications	✓	✓											✓	✓
5	20EIO03	Industrial Automation	✓	✓	✓	✓	✓								✓	✓
5	20EIO04	Measurements and Instrumentation	✓	✓	✓	✓	✓								✓	✓
6	20EIO05	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓								✓	✓
6	20EIO06	PLC Programming and Its Applications	✓	✓	✓	✓	✓								✓	✓
6	20EIO07	Instrumentation for Industry 4.0	✓	✓	✓	✓	✓								✓	✓
8	20EIO08	Graphical Programming using Virtual Instrumentation	✓	✓	✓	✓	✓								✓	✓
8	20EIO09	Testing of Materials	✓	✓	✓	✓	✓								✓	✓
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	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	✓	✓	✓											
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	20EEO04	Energy Conservation and Management	✓	✓	✓		✓									
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 Augument 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	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	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	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		General Open Elective														
4,5,6,8	20GEO01	German Language Level 1								✓	✓	✓		✓		
4,5,6,8	20GEO02	Japanese Language Level 1								✓	✓	✓		✓		
5	20GEO03	Design Thinking for Engineers	✓	✓	✓											
6	20GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
4,5,6,8	20GEO05	German Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO06	German Language Level 3								✓	✓	✓		✓		
4,5,6,8	20GEO07	German Language Level 4								✓	✓	✓		✓		
4,5,6,8	20GEO08	Japanese Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO09	Japanese Language Level 3								✓	✓	✓		✓		
4,5,6,8	20GEO10	Japanese Language Level 4								✓	✓	✓		✓		
4,5,6,8	20GEO11	NCC Studies (Army Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
4,5,6,8	20GEO12	NCC Studies (Air Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
4,5,6,8	20GEO13	French Language Level 1								✓	✓	✓		✓		
4,5,6,8	20GEO14	French Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO15	French Language Level 3								✓	✓	✓		✓		
4,5,6,8	20GEO16	Spanish Language Level 1								✓	✓	✓		✓		
4,5,6,8	20GEO17	Spanish Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO18	Spanish Language Level 3								✓	✓	✓		✓		
8	20GEO19	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020
(For the students 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
20EIT11	Electron Devices and Circuits	3	0	0	3	50	50	100	ES
20EIT12	Circuit Theory	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20EIL11	Circuits and Devices 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
20CYT23	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
20PHT24	Materials Science and Solid State Devices	3	0	0	3	50	50	100	BS
20EIT21	Transducers Engineering	3	0	0	3	50	50	100	PC
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
Practical / Employability Enhancement									
20MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
20PHL26	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					**22**				

*Alternate Weeks

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020
(For the students 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									
20MAT32	Probability, Transforms and Partial Differential Equations	3	1	0	4	50	50	100	BS
20CSC31	Programming in C	3	0	2	4	50	50	100	ES
20EIT31	Networks, Signals and Systems	3	1	0	4	50	50	100	PC
20EIT32	Analog Integrated Circuits	3	0	0	3	50	50	100	PC
20EIT33	Electrical Measurements and Instrumentation	3	0	0	3	50	50	100	PC
Practical / Employability Enhancement									
20EGL31	English for work place Communication Laboratory	0	0	2	1	50	50	100	HS
20EIL31	Transducers and Measurements Laboratory	0	0	2	1	50	50	100	PC
20EIL32	Analog Integrated Circuits Laboratory	0	0	2	1	50	50	100	PC
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									
20MAT41	Statistics and Numerical Methods	3	1	0	4	50	50	100	BS
20CSC41	Python Programming	3	0	2	4	50	50	100	ES
20EIT41	Industrial Instrumentation-I	3	0	0	3	50	50	100	PC
20EIT42	Digital Logic Circuits	3	1	0	4	50	50	100	ES
20EIT43	Electrical Machines and Drives	3	0	0	3	50	50	100	PC
	Open Elective I	3	1/0	0/2	4	50	50	100	**OE**
Practical / Employability Enhancement									
20EIL41	Instrumentation System Design Laboratory	0	0	2	1	50	50	100	PC
20EIL42	Virtual Instrumentation 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**				

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

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EIT51	Control Systems	3	1	0	4	50	50	100	PC
20EIT52	Microprocessor and Microcontroller	3	0	0	3	50	50	100	PC
20EIT53	Industrial Instrumentation – II	3	0	0	3	50	50	100	PC
	Professional Elective-I	3	0	0	3	50	50	100	PE
	Open Elective **II**	3	0/1	2/0	4	50	50	100	OE
Practical / Employability Enhancement									
20EIL51	Electrical Machines and Control Laboratory	0	0	2	1	50	50	100	PC
20EIL52	Microcontroller and Interfacing Laboratory	0	0	2	1	50	50	100	PC
20EIL53	Industrial Instrumentation 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					**22**				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EIT61	Process Control	3	0	0	3	50	50	100	PC
20EIT62	Digital Signal Processing	3	1	0	4	50	50	100	PC
20EIT63	Logic and Distributed Control Systems	3	0	0	3	50	50	100	PC
	Open Elective **III**	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20EIL61	Process Control Laboratory	0	0	2	1	50	50	100	PC
20EIL62	Signal Processing and Embedded Systems Laboratory	0	0	2	1	50	50	100	PC
20EIL63	Logic and Distributed Control Systems Laboratory	0	0	2	1	50	50	100	PC
20EIP61	Project Work I	0	0	4	2	100	0	100	EC
20GEL61/ 20GEI61	Professional Skills Training II / Industrial Training II	---	---	---	2	100	0	100	EC
20GEP61	Comprehensive Test and Viva	0	0	0	2	100	0	100	EC
Total Credits to be earned					**22**				

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

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20GET71	Engineering Economics and Management	3	0	0	3	50	50	100	HS
20EIT71	Industrial Data Communication	3	0	0	3	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	PE
Practical / Employability Enhancement									
20EIP71	Project Work-II Phase-I	0	0	12	6	50	50	100	EC
Total Credits to be earned					**24**				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Open Elective 4	3	0	0	3	50	50	100	OE
	Professional Elective 6	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20EIP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					**10**				

Total Credits: 169

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020
(with the inclusion of Amendment No.2022.18.07)
(For the students admitted in the academic year 2021-22)

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	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
20EIT11	Electron Devices and Circuits	3	0	0	3	40	60	100	ES
20EIT12	Circuit Theory	3	1	0	4	40	60	100	PC
Practical / Employability Enhancement									
20EIL11	Circuits and Devices 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				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
20CYT23	Chemistry of Electronic Materials	3	0	0	3	40	60	100	BS
20PHT24	Materials Science and Solid State Devices	3	0	0	3	40	60	100	BS
20CSC31	Programming in C	3	0	2	4	50	50	100	ES
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
Practical / Employability Enhancement									
20MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
20PHL26	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. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020
(For the students 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									
20MAT32	Probability, Transforms and Partial Differential Equations	3	1	0	4	40	60	100	BS
20CSC34	Data Structures using C	3	0	2	4	50	50	100	ES
20EIT21	Transducers Engineering	3	0	0	3	40	60	100	PC
20EIT32	Analog Integrated Circuits	3	0	0	3	40	60	100	PC
20EIT33	Electrical Measurements and Instrumentation	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
20EGL31	English for work place Communication Laboratory	0	0	2	1	60	40	100	HS
20EIL31	Transducers and Measurements Laboratory	0	0	2	1	60	40	100	PC
20EIL32	Analog Integrated Circuits Laboratory	0	0	2	1	60	40	100	PC
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**22**				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20MAT41	Statistics and Numerical Methods	3	1	0	4	40	60	100	BS
20EIT31	Networks, Signals and Systems	3	1	0	4	40	60	100	PC
20EIT41	Industrial Instrumentation - I	3	0	0	3	40	60	100	PC
20EIT42	Digital Logic Circuits	3	1	0	4	40	60	100	ES
20EIT43	Electrical Machines and Drives	3	0	0	3	40	60	100	PC
	Open Elective I	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20EIL41	Instrumentation System Design Laboratory	0	0	2	1	60	40	100	PC
20EIL42	Virtual Instrumentation 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**				

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

SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20EIT51	Control Systems	3	1	0	4	40	60	100	PC
20EIT52	Microprocessor and Microcontroller	3	0	0	3	40	60	100	PC
20EIT53	Industrial Instrumentation – II	3	0	0	3	40	60	100	PC
	Professional Elective-I	3	0	0	3	40	60	100	PE
	Open Elective **II**	3	0/1	2/0	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20EIL51	Electrical Machines and Control Laboratory	0	0	2	1	60	40	100	PC
20EIL52	Microcontroller and Interfacing Laboratory	0	0	2	1	60	40	100	PC
20EIL53	Industrial Instrumentation 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					**22**				

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20EIT61	Process Control	3	0	0	3	40	60	100	PC
20EIT62	Digital Signal Processing	3	1	0	4	40	60	100	PC
20EIT63	Logic and Distributed Control Systems	3	0	0	3	40	60	100	PC
	Open Elective **III**	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
20EIL61	Process Control Laboratory	0	0	2	1	60	40	100	PC
20EIL62	Signal Processing and Embedded Systems Laboratory	0	0	2	1	60	40	100	PC
20EIL63	Logic and Distributed Control Systems Laboratory	0	0	2	1	60	40	100	PC
20EIP61	Project Work I	0	0	4	2	100	0	100	EC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
20GEP61	Comprehensive Test and Viva	0	0	0	2	100	0	100	EC
Total Credits to be earned					**20**				

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

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20GET71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
20EIT71	Industrial Data Communication	3	0	0	3	40	60	100	PC
	Professional Elective 2	3	0	0	3	40	60	100	PE
	Professional Elective 3	3	0	0	3	40	60	100	PE
	Professional Elective 4	3	0	0	3	40	60	100	PE
	Professional Elective 5	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
20EIP71	Project Work II Phase I	0	0	12	6	50	50	100	EC
Total Credits to be earned					**24**				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Open Elective 4	3	0	0	3	40	60	100	OE
	Professional Elective 6	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
20EIP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					**10**				

Total Credits: 169

PROFESSIONAL ELECTIVE (PE)						
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
		SEMESTER V				
		Elective - I				
1.	20EIE01	Biomedical Instrumentation	3	0	0	3
2.	20EIE02	Embedded Systems	3	0	0	3
3.	20EIE03	Soft Computing Techniques	3	0	0	3
4.	20EIE04	Piping and Instrumentation Diagrams	3	0	0	3
5.	20EIE05	Industrial Electronics and Drives	3	0	0	3
6.	20EIE06	Advanced Control Theory	3	0	0	3
		SEMESTER VII				
		Elective - II				
7.	20EIE07	Analytical Instrumentation	3	0	0	3
8.	20EIE08	Instrumentation System Design	3	0	0	3
9.	20EIE09	Digital Image Processing	3	0	0	3
10.	20EIE10	Power Plant Instrumentation	3	0	0	3
11.	20EIE11	Wireless Instrumentation	3	0	0	3
12.	20EIE12	Advanced PID Control	3	0	0	3
13.	20GEE01	Fundamentals of Research	3	0	0	3
		Elective - III				
14.	20EIE13	Fiber Optics and Laser Instruments	3	0	0	3
15.	20EIE14	Wearable Technology	3	0	0	3
16.	20EIE15	Deep Neural Networks for Computational Imaging	3	0	0	3
17.	20EIE16	Instrumentation Techniques in Agriculture	3	0	0	3
18.	20EIE17	Industrial Internet of Things	3	0	0	3
19.	20EIE18	Optimal and Adaptive Control	3	0	0	3
20.	20EIE19	Total Quality Management	3	0	0	3
		Elective - IV				
21.	20EIE20	Safety in Process Industries	3	0	0	3
22.	20EIE21	VLSI Systems	3	0	0	3
23.	20EIE22	MEMS and Nano Technology	3	0	0	3
24.	20EIE23	Instrumentation in Aircraft Navigation and Control	3	0	0	3
25.	20EIE24	Machine Learning and Its Applications	3	0	0	3

26.	20EIE25	Control System Components	3	0	0	3
		Elective - V				
27.	20EIE26	Multi Sensor Data Fusion	3	0	0	3
28.	20EIE27	Electronic Instrumentation	3	0	0	3
29.	20EIE28	Artificial Intelligence	3	0	0	3
30.	20EIE29	Instrumentation and Control in Process Industries	3	0	0	3
31.	20EIE30	Intelligent Robotic Systems	3	0	0	3
32.	20EIE31	Computer Control of Processes	3	0	0	3
SEMESTER VIII						
		Elective - VI				
33.	20EIE32	Diagnostic and Therapeutic Instruments	3	0	0	3
34.	20EIE33	3D Printing Hardware	3	0	0	3
35.	20EIE34	Neuroimaging for Data Analysis	3	0	0	3
36.	20EIE35	Instrumentation and Control in Petro Chemical Industries	3	0	0	3
37.	20EIE36	VHDL Programming and Its Applications	3	0	0	3
38.	20EIE37	Model Predictive Control	3	0	0	3
Total Credits to be earned						**18**

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20EIO01	Digital Image Processing and Its Applications	3	1	0	4	IV
2.	20EIO02	Industrial Automation	3	1	0	4	V
3	20EIO03	Measurements and Instrumentation	3	1	0	4	V
4	20EIO04	Biomedical Instrumentation and Applications	3	0	0	3	VI
5	20EIO05	PLC Programming and Its Applications	3	0	0	3	VI
6.	20EIO06	Instrumentation for Industry 4.0	3	0	0	3	VI
7.	20EIO09	Instrumentation Techniques in Agriculture	3	0	0	3	VI
8.	20EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	VI
9.	20EIO08	Testing of Materials	3	0	0	3	VIII
10.	20EIO10	Industrial Data Communication	3	0	0	3	VIII
11.	20EIO11	Wireless Instrumentation	3	0	0	3	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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – I**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – II**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – III**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IV**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – V**	**9**
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", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1.	Sanjay Kumar and Pushp Lata, "Communication Skills", 2nd 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.

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

Mapping of COs with POs and PSOs

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

ASSESSMENT PATTERN - THEORY

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)**

20MAC11 - MATRICES AND DIFFERENTIAL EQUATIONS
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	1*	2*	4

Preamble	To provide the skills to the students for solving different real time problems by applying matrices and 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} – cosax / sinax – x^n – $e^{ax}x^n$, e^{ax}sinbx and e^{ax}cosbx – x^nsinax and x^ncosax – 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", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1.	Kreyszig E., "Advanced Engineering Mathematics", 10th 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", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	MATLAB Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	solve engineering problems which needs matrix computations.	Applying (K3)
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)

Mapping of COs with POs and PSOs

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

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)**

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_2 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",11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of the concepts of oscillatory and wave motion to comprehend the phenomena related to the propagation of elastic waves.	Applying (K3)
CO2	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)

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	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”, 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019.

REFERENCES:

1.	Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., “Applied Chemistry”, 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
2.	Payal B. Joshi, Shashank Deep, “Engineering Chemistry”, Oxford University Press, New Delhi, 2019.
3.	Palanna O., “Engineering Chemistry”, McGraw Hill Education, New Delhi, 2017.

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

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	1												
CO5	3	1												

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

ASSESSMENT PATTERN - THEORY

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

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

20EIT11–ELECTRON DEVICES AND CIRCUITS

Programme& Branch	B.E. &Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**1**	**ES**	**3**	**0**	**0**	**3**

Preamble	Electron Devices and circuits provide information about the applications of diodes and special diodes. It also deals with the stability, small signal analysis of BJT, different types of amplifiers and feedback circuits along with the applications.	
Unit - I	**Title:Diode Applications and Special Devices:**	**9**
Introduction – Diode as a circuit element – PN Diode Applications: Clippers, Clampers, Voltage multiplier and Linear mode power supply. Special diodes: Varactor diode – Tunnel diode –PIN diode - LCD – LDR - Surface Mount Devices – OLED.		
Unit - II	**BJT Biasing and Stabilization:**	**9**
Introduction - Bias Stability – Need for Biasing –DC Load line – AC Load line - Thermal runaway –Stability Factor– Methods of Transistor Biasing: Fixed bias circuits, Emitter-feedback bias and Voltage - divider bias.		
Unit - III	**Mid-Band Analysis of BJT:**	**9**
Introduction – Two-port Devices and Network Parameters – The Hybrid Model for Two-port network – Analysis of a transistor amplifier circuit using h-parameters **–Simplified CE Hybrid Model –**Analysis of CC Amplifier using the Approximate Model.		
Unit - IV	**Differential Amplifier, Large Signal Amplifier and Tuned Amplifier:**	**9**
Differential amplifier using BJT – Differential and common mode gain, CMRR. Large Signal Amplifiers: Classification based on Biasing Condition - Class A Large Signal Amplifiers - Class B Amplifier and Push Pull amplifier. Tuned amplifiers– Q-Factor – Effect of cascading Single Tuned Amplifier – Effect of Cascading Double Tuned Amplifier.		
Unit - V	**Feedback amplifiers, Oscillators and Multivibrators:**	**9**
Feedback amplifiers– Basic Concept of Feedback - Effects of negative feedback – Types of Negative Feedback Connections: Voltage / current, series/shunt feedback amplifiers. Oscillators: Classification of Oscillators - Conditions for Oscillation – RC oscillators. Multivibrators: Astable, Monostable and BistableMultivibrators.		

Total:45

TEXT BOOK:

1	Salivahanan S.,and Suresh Kumar, “Electronic Devices and Circuit”, 4th Edition, Mc.Graw Hill Education (India) Private Limited, Bengaluru, **2016**

REFERENCES:

1	Robert L. Boylestad, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson New International Edition, New Delhi, 2015.
2	David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, Noida, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the diode circuits and special electronic devices for various applications	Understanding (K2)
CO2	determine the stability of BJT	Applying (K3)
CO3	Illustrate the small signal analysis of BJT	Applying (K3)
CO4	explain the construction, operation and application as differential, tuned and power amplifiers	Understanding (K2)
CO5	design of feedback and multivibrator circuits	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	15	45	35				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	10	50	40				100

*** ±3% may be varied**

20EIT12–CIRCUIT THEORY

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

Preamble	To establish a firm understanding of basic laws of electric circuits and to provide a comprehensive insight into the techniques for analysing the circuits theoretically	
Unit - I	**DC Circuits:**	**9+3**
Review of electric circuit elements and Kirchoff's Laws-Dependent and independent sources- open and short circuit- Source transformation-Voltage and current relationship in R,L and C- Power and energy in series and parallel circuits.		
Unit - II	**Single phase AC Circuits:**	**9+3**
Review of alternating sinusoidal voltages and currents-phase relation in resistor,inductor,capacitor-Impedance diagram-Phasor diagram-Series circuits-parallel circuits-compound circuits-Instantaneous power-average power-apparent power and power factor-reactive power-the power triangle.		
Unit - III	**Three phase AC circuits:**	**9+3**
Advantages of three phase system -Generation of three phase voltages - Phase sequence - Interconnection of three phase sources and loads -Voltage, current and power in three phase star and delta connected system - Three phase balanced circuits-Power measurement in three phase balanced circuits: Two wattmeter method.		
Unit - IV	**Time and Frequency response analysis:**	**9+3**
Steady state analysis of RL, RC and RLC circuits- Transient analysis of RL RC and RLC circuits.R**esonance analysis:** Ideal RLC series and parallel resonance-Impedance and current variations- Bandwidth-Q factor- Magnification factor-Locus diagrams: Circle equation for RL series circuit.		
Unit - V	**Coupled Circuits:**	**9+3**
Mutual Inductance -Dot convention – Coefficient of coupling – Ideal transformer – Series and parallel connections of coupled circuits - Single tuned circuit - Analysis of magnetic circuit-Comparison of electric and magnetic circuits.		

Lecture: 45, Tutorial:15,Total: 60

TEXT BOOK:

1.	Sudhakar A. &Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis" 5th Edition, Tata McGraw-Hill, New Delhi, 2015.

REFERENCES:

1.	Ravish R.Singh, "Networks Analysis and Synthesis", 2nd Edition, Tata McGraw-Hill, New Delhi, 2013

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	determine the electrical parameters in the fundamental DC circuit	Applying (K3)
CO2	analyze the behavior of RLC circuits under single phase AC excitation	Applying (K3)
CO3	determine the electrical parameters in three phase AC circuits	Applying (K3)
CO4	analyze the characteristics of RLC circuits in time and frequency domain	Applying (K3)
CO5	determine the electrical and magnetic parameters in the magnetically coupled circuits	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

20EIL11– CIRCUITS AND DEVICES LABORATORY

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	0	0	2	1
Preamble	The Devices and circuits lab aims to assist the students in obtaining a better understanding of the operation of electrical and electronic circuits experimented by applying the theorem, determining the parameters, generating and analysing the waveforms.						

List of Exercises / Experiments:

1.	Build the clipper and clamper circuits using diodes and examine the waveforms
2.	Determine the hybrid parameters of BJT
3.	Determine the CMRR value of differential amplifier
4.	Obtain the frequency response of tuned amplifier
5.	Verification of Thevenin's theorem in voltage divider bias on BJT
6.	RC transient response analysis in wave shaping circuits
7.	Frequency Response analysis of RLC circuits
8.	Measurement of power and power factor in single phase and three phase loads
9.	Generate Sine wave using BJT based RC Phase shift Oscillator and Calculate its Frequency
10.	Generate Sine wave using BJT based Astable Multivibrator and Calculate its Frequency

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the characteristics and parameters of diodes and transistors	Applying (K3), Precision (S3)
CO2	generate waveforms using PN junction diode and BJT	Applying (K3),

		Precision (S3)
CO3	examine the circuit using Thevinins theorem and analyze the time and frequency response of RC and RLC circuits	Applying (K3), Precision (S3)

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

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 $Ca^{2+}$and 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:

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

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).	
Unit - I	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VI**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VII**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VIII**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IX**	**9**
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	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – X**	**9**
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”, 4th Edition, Cambridge University Press, New York, 2017.

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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use functional grammar for improving communication skills	Applying (K3)
CO2	listen and comprehend different 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)

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	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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		20	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)**

20MAC21 - MULTIVARIABLE CALCULUS AND COMPLEX ANALYSIS

(Common to All Engineering and Technology Branches)

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", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1.	Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
2.	Dass H K, "Higher Engineering Mathematics", 3rd Revised Edition, S.Chand and Co., New Delhi, 2014.
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	MATLAB Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (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)**

20PHT24 - MATERIALS SCIENCE AND SOLID STATE DEVICES

(Common to Electrical and Electronics Engineering and Electronics and Instrumentation Engineering branches)

Programme & Branch	**BE-Electrical and Electronics Engineering and BE-Electronics and Instrumentation Engineering**	**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, nanomaterials, biomaterials and smart materials. It also describes the working of the select solid state devices and the applications of aforementioned materials in Electrical, Electronics and Instrumentation Engineering and provides motivation towards innovations.	
Unit - I	**Conducting and Superconducting Materials:**	**9**
Conducting Materials: Introduction – Classical free electron theory – Success and failures of classical free electron theory – Quantum free electron theory of metals – Fermi distribution function – Effect of temperature on Fermi distribution function – Density of energy states for a metal – Carrier concentration in a metal – Superconducting Materials: Properties – Type I and Type II superconductors – Applications: Cryotron, Superconducting quantum interference device (SQUID).		
Unit - II	**Semiconducting Materials:**	**9**
Intrinsic semiconductor: Carrier concentration, variation of Fermi level with temperature, electrical conductivity and band gap - Extrinsic semiconductors: Carrier concentration in n-type and p-type semiconductors, variation of Fermi level with temperature and impurity concentration - Homojunction semiconductor laser: Construction, working and applications – Heterojunction semiconductor laser (qualitative) - Hall effect: Theory and experimental determination of Hall coefficient - Applications.		
Unit - III	**Solid State Devices:**	**9**
Introduction **-** Uni-junction transistor: Construction and characteristics – Junction field effect transistor: Construction and characteristics – Metal oxide semiconductor field effect transistor: Construction and characteristics – Silicon controlled rectifier: Construction and characteristics - Diac and triac: Construction and characteristics – Photodiode and phototransistor: Construction and characteristics.		
Unit - IV	**Magnetic and Dielectric Materials:**	**9**
Magnetic Materials: Introduction – Domain theory of ferromagnetism – Hysteresis loss – Soft and hard magnetic materials – Ferrites: Properties, Structures and applications – Transformer core: Materials and types – Dielectric Materials: Introduction – Electronic, Ionic, Orientational and Space charge polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Applications of dielectric materials		
Unit - V	**Nanomaterials and Biomaterials:**	**9**
Nanomaterials: Introduction **-** Low dimensional structures: Quantum well, quantum wire and quantum dot – Synthesis techniques:		

Ball milling, Lithography and Physical vapour deposition – Applications of nanomaterials – Carbon nanotubes: Structures, properties, synthesis by laser ablation method and applications - Bio materials: Introduction – Basic requirements of biomaterials – Biocompatibility – Classification of biomaterials – Metallic and alloy biomaterials (qualitative): Cobalt–chromium alloys and Titanium and titanium alloys.

Total:45

TEXT BOOK:

1.	Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics",11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019, for Unit I, II, IV, V.
2.	Albert Malvino and David J. Bates, "Electronic Principles", 8th Edition, McGraw-Hill Publications, New Delhi, 2016, for Unit III.

REFERENCES:

1.	Mehta V. K. and Rohit Mehta, "Principles of Electronics", 23rd Edition, S.Chand and Company Limited, New Delhi, 2005.
2.	Thomas L. Floyd, "Electronic Devices", 10th Edition, Pearson Education, New York, 2018.
3.	Tamilarasan K. and Prabu K., "Materials Science", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the concepts of classical and quantum free electron theory of metals to comprehend the effect of temperature on Fermi function and to compute the density of states in metals, and to explain the types, properties and applications of superconductors (Cryotron and Superconducting quantum interference device).	Applying (K3)
CO2	use the concepts of density of states to compute the carrier concentration, electrical conductivity and band gap of intrinsic semiconductor and to compute the carrier concentration of extrinsic semiconductors, working of semiconductor laser, Hall effect and its applications.	Applying (K3)
CO3	describe the construction, working and characteristics of select electronic devices using the concept of carrier transport in semiconductors.	Applying (K3)
CO4	apply the domain theory of ferromagnetism to explain hysteresis and to explain structure, properties and applications of ferrites, and to apply the concept of electric dipole moment and electric polarization to compute the polarisability of select polarization mechanisms in dielectrics and to describe the related phenomenon.	Applying (K3)
CO5	utilize appropriate methods to prepare nano-materials and carbon nano-tubes, and to comprehend their properties, types and applications. To discuss the properties, select types and applications of biomaterials.	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". 2nd 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.

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

20VEC11 – YOGA VALUES FOR HOLISTIC DEVELOPMENT
(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	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	
Unit - I	**Physical Health:**	**4**
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, Acu pressure, Relaxation exercises - Benefits. **Yogasanas:** Pranamasana - Hastha Uttanasana - Pada Hasthasana - Aswa Sanjalana Asana - Thuvipatha asva 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:**	**4**
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:**	**4**
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:**	**4**
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):**	**4**
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).		

Total:20

TEXT BOOK:

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

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.

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

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

ASSESSMENT PATTERN							
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)**

20MEC11 – ENGINEERING DRAWING
(Common to ECE, EEE, EIE, CSE, IT Branches)

Programme & Branch	BE(ECE, EEE, EIE,CSE) &BTech(IT)	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**2**	**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”, 15th Edition, New Age International Pvt. Ltd., New Delhi, 2018.

REFERENCES:

1. Basant Agrawal, Agrawal C.M., “Engineering Drawing”, 2nd 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”, 1st Edition, Oxford University Press, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes.	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)

Mapping of COs with POs and PSOs

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

ASSESSMENT PATTERN - THEORY

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

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

20EIT21–TRANSDUCERS ENGINEERING

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

Preamble	This course explains the basic concepts of Measurement Systems, Units, and Standards, Classification of Transducers and Characteristics of Transducers. Also impart theoretical and practical aspects of Resistive, Inductive, Capacitive and other special types of transducers.	
Unit - I	**Measurements and Instrumentation of Transducers:**	**9**
Functional blocks of a Measurement system. Fundamental and Derived units –Standards of Measurement. Classification of Errors: Error analysis, Statistical methods, Odds and uncertainty. Classification of transducers – Selection of transducers.		
Unit - II	**Characteristics of Transducers:**	**9**
Static characteristics: Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Range and Span. **Dynamic characteristics**: Impulse and random response of Zero order transducer. Step and Ramp response of First order transducer.		
Unit - III	**Variable Resistance Transducers:**	**9**
Resistive Transducers: Resistance Potentiometer: Loading effect on Potentiometer. Resistance Strain gauges: Unbonded and Bonded type strain gauges. **Applications:** Temperature Measurement using RTD and Thermistor – Gas flow measurement using hot-wire Anemometer – measurement of moisture in solids and wood – level measurement using resistive tapes.		
Unit - IV	**Variable Inductance Transducers:**	**9**
Inductive Transducers: Simple inductance and Mutual inductance Transducers – Induction Potentiometers. Linear Variable Differential Transformers – Variable reluctance transducers – Eddy current transducers. **Applications**: Displacement measurement - Thickness Measurement – Position Measurement.		
Unit - V	**Variable Capacitance Transducers and Other Transducers:**	**9**
Capacitive Transducers: Variable area type – Variable dielectric type – Variable distance type. Applications:CapacitiveThicknessTransducers–CapacitiveMoistureTransducers - Capacitive Level Transducer. **Other Transducers:** Piezoelectric Transducers - Magnetostrictive Transducers – Hall Effect Transducers – SQUID Sensors – Smart sensors.		

Total: 45

TEXT BOOK:

1	Vijayachitra S., "Transducers Engineering" 1st Edition, Prentice Hall of India, New Delhi,2016.

REFERENCES:

1	Murthy D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of India, New Delhi, 2010.
2	Doebelin E.A., “Measurement Systems: Applications and Design”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret knowledge on the measurement of physical quantities, conversion and classification of transducers	Understanding (K2)
CO2	Summarize the concepts of various characteristics of Transducers	Understanding (K2)
CO3	categorize the types of resistive transducers and apply them for various applications	Applying (K3)
CO4	discuss the types of inductive transducers and apply them for various applications	Applying (K3)
CO5	classify and apply various types of capacitive transducers for diverse applications	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1						1					2	2
CO2	3	1						1					2	2
CO3	3	2	1	1				2				1	3	3
CO4	3	2	1	1				2				1	3	3
CO5	3	2	1	1				2				1	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	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

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

20PHL26 - PHYSICAL SCIENCES LABORATORY II

Prog. & Branch	BE - Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Pre requisite	Nil	2	BS	0	0	2	1

Preamble	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 Cl^-, Cr^{6+}, DO, Fe^{2+} and Cu^{2+} and thereby, to improve the analytical capability.

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 (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:

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

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

20MEL11 –ENGINEERING PRACTICES LABORATORY
(Common to ECE, EEE, EIE, CSE & IT Branches)

Programme & Branch	BE (ECE, EEE, EIE, CSE) & BTech (IT)	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	ES	0	0	2	1

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

List of Exercises / Experiments:

	PART A – MECHANICAL ENGINEERING
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
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	plan the sequence of operations for effective completion of the planned models/ innovative articles	Creating (K6), 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

20MAT32 - PROBABILITY, TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

((Common to Electrical and Electronics Engineering & Electronics and Instrumentation Engineering branches)

Programme & Branch	B.E. - Electrical and Electronics Engineering, Electronics and Instrumentation Engineering branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**3**	**BS**	**3**	**1**	**0**	**4**

Preamble	To provide the skills for handling discrete and continuous time signals by applying Fourier transform and Z-Transform and impart knowledge in probability and partial differential equations and express functions in terms of Fourier series.	
Unit - I	**Random Variables and Probability distributions:**	**9+3**
Random Variables: Introduction – Discrete and Continuous random variables – Probability Mass and Probability density functions – Mathematical expectation and Variance – Moments – Moment generating functions. Standard Probability Distributions: Discrete Distributions: Binomial distribution – Poisson distribution – Continuous Distributions: Exponential distribution – Normal distribution.		
Unit - II	**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 - III	**Partial Differential Equations:**	**9+3**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients.		
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.	Ravish R Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1.	Jay L. Devore., "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.
2.	Veerarajan T., "Transforms and Partial Differential Equations", 3rd Reprint, Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 2013.
3.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, Limited, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	classify random variables and apply suitable distributions in practical problems.	Applying (K3)
CO2	express the given function or data in terms of Fourier series.	Applying (K3)
CO3	formulate and solve higher order partial differential equations.	Applying (K3)
CO4	understand the concept of Fourier transform and its properties which will provide the ability to formulate and solve some of the physical problems in engineering.	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	3	2											
CO2	3	3	1											
CO3	3	3	1											
CO4	3	3	2											
CO5	3	3	2											

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

ASSESSMENT PATTERN - THEORY

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

Preamble	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.	
Unit - I	**Introduction to Computer and Problem Solving:**	**9**
Overview of computers : Types, Generations, Characteristics, Basic computer Organization – Problem solving techniques: Algorithms - Flowcharts – Pseudo codes – Structuring the logic: Sequential, selection and repetitive structure		
Unit - II	**Introduction to C and Control Statements:**	**9**
The structure of a C program – Compiling and executing C program – C Tokens – Character set in C – Keywords – identifiers- Basic data Types – Variables – constants – Input/Output statements – operators - decision making and looping statements		
Unit - III	**Arrays and Functions:**	**9**
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		
Unit - IV	**Strings and Pointers:**	**9**
Strings :Introduction – operations on strings : finding length, concatenation, comparing and copying – string and character manipulation functions, Arrays of strings. Pointers : declaring pointer variables – pointer expression and arithmetic, passing arguments to function using pointers -pointers and 1D arrays –arrays vs pointers , pointers and strings,		
Unit - V	**User-defined Data Types and File Handling:**	**9**
User-defined data types: Structure: Introduction – nested structures– arrays of structure – structure and functions -unions – enumerated data type. File Handling : Introduction - opening and closing files – reading and writing data to files -Manipulating file position indicator : fseek(), ftell() and rewind()		

List of 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 ”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

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

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

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

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	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	Title	Hours
Unit – I	**List:**	**9**
Data Structures - Abstract Data Types (ADT) - List ADT and Array Implementation - Linked List - Doubly Linked List - Circular Linked List – Application : Polynomial Addition		
Unit – II	**Stack and Queues:**	**9**
Stack ADT – Array and Linked List implementation of Stacks - Application: Balancing Parenthesis- Infix to Postfix Conversion - Postfix Expression Evaluation - Queue ADT – Array and Linked List implementation of Queues - Applications		
Unit – III	**Trees:**	**9**
Trees-Preliminaries – Binary Trees –Binary Tree Traversals - The Search Tree ADT – Binary Search Trees–Priority Queues (Binary Heap)- Application: Expression Tree		
Unit – IV	**Graphs:**	**9**
Graphs – Definitions – Elementary Graph Operations- Traversals – Shortest-Path Algorithms: Unweighted Shortest Paths – Dijkstra"s Algorithm – Minimum Spanning Tree: Prim"s Algorithm- Kruskal"s Algorithm – Applications: Biconnectivity.		
Unit – V	**Sorting and Hashing:**	**9**
Sorting - Preliminaries – Insertion Sort – Quicksort – Merge sort – Heapsort – Hashing – General Idea – Hash Function – Separate Chaining – Open addressing.		

LIST OF EXPERIMENTS / EXERCISES:

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

Lecture:45, Practical:30, Total:75

TEXT BOOK:

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

REFERENCES/ MANUAL / SOFTWARE:

1.	Horowitz Sahni, Andreson Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, Hyderabad, 2011.
2.	Langsam Y.M., Augenstein J. and Tenenbaum A. M., “Data Structures using C and C++”, 2nd Edition, Pearson Education, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply List ADT for solving the given problems	Applying (K3) 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)

20EIT31–NETWORKS, SIGNALS AND SYSTEMS

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

Preamble	To impart knowledge on electric circuit analysis and synthesis and to provide fundamental concepts of continuous and discrete signals and systems	
Unit - I	**Network Theorems in DC & AC Circuits:**	**9+3**
Mesh and Nodal analysis -Star delta transformation-Superposition theorem. Thevenin's theorem -Norton's theorem-Maximum power transfer theorem.		
Unit - II	**Network Functions and Synthesis:**	**9+3**
Network functions: transfer functions of one port and two port networks- ladder network-open and short circuit parameters. Network Synthesis: Realizability of one port network- Hurwitz polynomials-Positive Real Functions- RL, RC network using Cauer methods, LC networks using Foster method-applications of passive networks synthesize in filters		
Unit - III	**Continuous and Discrete Time Signals**:	**9+3**
Classification- Analog to Digital conversion- Sampling – Aliasing - Signal representation: step, ramp, parabolic, sinusoidal and exponential. Periodical signals-Odd and Even signals-Energy and Power signals - Signal transformations.		
Unit - IV	**Continuous and Discrete Time Systems:**	**9+3**
Classification of systems: static and dynamic -time variant and invariant – linear and nonlinear - stable and unstable- causal and non causal-recursive and non recursive. Relation between Laplace and Z transform-Response analysis of linear systems with impulse and step input in continuous and discrete domain using Laplace and Z transform.		
Unit - V	**Analysis of Continuous and Discrete Signals:**	**9+3**
Relation between Laplace and Fourier transform- Trigonometric and exponential form of Fourier series of periodical signals in continuous and discrete domain: sinusoidal signals-Full and half wave rectified sinusoidal signal. Fourier transform of aperiodical signals in continuous and discrete domain: Rectangular pulse, decaying Exponential signal- Parseval's theorem.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1	Ravish R. Singh, "Networks Analysis and Synthesis", 2nd Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2019 for Unit 1 and 2.
2	NagoorKani A., "Signals and Systems", McGraw Hill Education(India) Pvt. Ltd., New Delhi, 2010 for Unit 3,4 and 5.

REFERENCES:

1	Sudhakar A. &Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis" 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2015.
2	William H.Hayt, Jack E.Kemmerly, Jannie D.Philips, & Steven M.Durbin, "Engineering Circuit Analysis", 9th Edition, McGraw Hill Education (India) Pvt., Ltd, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply theorems to solve DC circuits	Applying (K3)
CO2	Apply theorems to solve AC circuits	Applying (K3)
CO3	analyze and synthesize the network functions	Analyzing (K4)
CO4	analyze continuous time signals and systems in time and frequency domain	Analyzing (K4)
CO5	Analyze discrete time signals and systems in time and frequency domain	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	2	2	2								3	3
CO4	3	3	2	2	2								3	3
CO5	3	2	1	1	1								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	5	20	65	10			100
CAT2	5	20	65	10			100
CAT3	5	20	65	10			100
ESE	10	10	70	10			100

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

20EIT32–ANALOG INTEGRATED CIRCUITS

Programme& Branch	B.E. &Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Electron Devices and Circuits**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	Analog Integrated Course dealt with circuits of signals free to vary from zero to full power supply voltage. The contents in this course make use of Integrated Circuit components constructed using Opamps, Special function ICs.	
Unit - I	**Basics and Characteristics of OPAMP:**	**9**
Introduction-Basics information of operational amplifier -Ideal operational amplifier –Operational amplifier Internal Circuit-Differential Amplifier-Transfer Characteristics. DC Characteristics: Input bias current-Input offset current-Input offset voltage -Thermal drift. AC characteristics: Frequency response-Frequency Compensation -Slew Rate.		
Unit - II	**Applications of Operational Amplifier**	**9**
Introduction-Inverting, Non inverting, Voltage follower, Summing Amplifier, Subtractor, Differentiator, Integrator, Comparators. Wave generators: Schmitt trigger, Astable and Monostable Multivibrator - RC phase shift oscillator. Precision diode. Active Filters: I order Low pass filters.		
Unit - III	**D-A and A-D Converters**:	**9**
Characteristics: Resolution, Quantization, Range, Settling time. Digital to Analog Converter: Types: Weighted R, R-2R and Inverted R-2R. Analog to Digital Converter: Types: Flash type, Dual slope, and Successive approximation, Sigma delta.		
Unit - IV	**Special ICs**:	**9**
Timer (IC 555) Introduction- Description of Functional block diagram - Monostable and Astable mode of operation. Voltage controlled oscillator (IC 566) – Monolithic Phase locked loop (IC 565).Voltage regulator IC: Series op-amp regulator (78XX) – Switching Mode Power Supply (SMPS).		
Unit - V	**Analog Signal Conditioning**:	**9**
Introduction- Analog Data Representation- Signal Level and Bias Changes, Linearization, conversions, Signal transmission: Current to Voltage converter. Differential Instrumentation Amplifier –Common mode rejection, Differential and Common Mode gain. Analog Controllers: Proportional, Integral and Derivative mode Controllers.		

Total:45

TEXT BOOK:

1	Roy Choudhry D. and Shail Jain," Linear Integrated Circuits" 4th Edition ,reprint, New Age International, New Delhi ,2015.

REFERENCES:

1	Curtis D. Johnson, “Process Control Instrumentation Technology” 8th Edition, Pearson EducationLimited, London, 2015.
2	Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4thEdition, Tata McGraw-Hill,New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the basics and characteristics of Opamp	Understanding (K2)
CO2	apply the circuit of Opamp for mathematical operation, waveform generation and filter.	Applying (K3)
CO3	implement A/D and D/A converters for real time application	Applying (K3)
CO4	Summarize the functional blocks of Special ICs.	Understanding (K2)
CO5	develop analog signal conditioning circuits to convert an input range of voltages to desired output voltage	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	50	40				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)**

20EIT33–ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

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

Preamble	The course imparts the knowledge on Principles, Constructions, Dynamics of Electrical and Electronic Measuring Instruments. It discusses the comprehensive techniques for measurement of current, voltage, power energy with Instruments, Potentiometers and Bridges.	
Unit - I	**Measurement of Voltage and Current**:	**9**
Introduction to essential requirements of instruments- Three operating forces of analog instruments - Permanent Magnet Moving Coil (PMMC): Construction of PMMC Instruments - Torque Equation- Ammeter Shunts- Voltmeter Multipliers. Moving Iron Instruments: General Torque Equation - Classification – Construction - Comparison between Attraction and Repulsion types of Instruments.		
Unit - II	**Measurement of Power and Energy**:	**9**
Introduction to Electrodynamometer type instruments- Electrodynamometer Wattmeter: Construction – Theory- Torque Equation- Errors. Single Phase Induction Type Meters: Construction –Theory and Operation of Single Phase Induction Type Energy Meters .Testing of Energy Meters: Phantom loading.		
Unit - III	**Potentiometers and Instrument Transformers**	**9**
D.C. Potentiometers: Introduction - Basic Potentiometer Circuit – Standardization - Laboratory type (Crompton's) potentiometer – Applications. Instrument Transformers: use of Instrument transformers- Ratios-Burden. Design Features of C.T Current Transformers (C.T) – Potential Transformers (P.T). Difference between C.T and P.T. Measurement of Power using Instrument Transformers.		
Unit - IV	**Measurement of Resistance and Impedance with Bridges:**	**9**
Classification of Resistances- Measurement of Medium Resistance - Wheat Stone Bridge - Limitations of Wheat Stone Bridge. Low Resistance- Kelvin Double Bridge. High Resistance – Meggar (Earth tester). A.C. Bridges: Introduction - Sources and Detectors - Measurement of Self Inductance & Capacitance: Maxwell's Inductance Bridge - Capacitance Bridge - Anderson's Bridge - Schering Bridge - Wien's Bridge- Sources of Errors in Bridge Circuits.		
Unit - V	**Digital Instrumentation (Block Diagram Approach):**	**9**
Digital Multimeter, Cathode Ray Oscilloscope**.** Impedance Measurement: Q meter. RMS Measurement: True RMS Meters. Digital meters: Time, Phase, Period and Frequency measurements. Digital Voltmeters: Ramp type Voltmeters. Current Probes, Shielding and Grounding**.**		

Total:45

TEXT BOOK:

1	Sawhney A.K. "A Course inElectronic Measurements and Instrumentation",2nd Edition, DhanpatRai& Co. Pvt. Ltd, New Delhi, 2015.

REFERENCES:

1	Robert B. Northrop, "Introduction to Instrumentation and Measurements", 3rd Edition, CRC Press, 2017.
2	Kalsi, H.S., "Electronic Instrumentation", 3rd Edition,Tata McGraw Hill Publishing Company, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	utilize the working principle of meters for measurement of Voltage and Current	Applying (K3)
CO2	utilize the working principle of meters for measurement of Power and Energy	Applying (K3)
CO3	make use of the concepts of potentiometers and instrument transformers for measuring electrical parameters.	Applying (K3)
CO4	carryout the measurement of Resistance and impedances using AC bridges	Applying (K3)
CO5	infer the recent developments in Digital Measurements and Instruments	Understanding (K2)

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

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	3	13	84				100
CAT3	7	50	43				100
ESE	10	50	40				100

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

20EIL31–TRANSDUCERS AND MEASUREMENTS LABORATORY

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**
Preamble	To infer the characteristics of various transducers and Perform various electrical measurements using Instruments and Bridges.						

List of Exercises / Experiments :

1.	Measurement of temperature using thermocouple, thermistor and resistance temperature detector and infer their I-O characteristics
2.	Measurement of strain using strain gauge and load cell and infer their characteristics as resistance transducers.
3.	(a). Measurement of displacement using inductive transducer and test its characteristics (b). Test the characteristics of DC potentiometer as resistance transducer
4.	Measurement of speed using photoelectric tachometer and proximity sensor
5.	(a). Test the characteristics of Hall effect transducers (b). Test the characteristics of Piezoelectric transducer.
6.	Range extension for DC ammeter and Voltmeter.
7.	Calibration of single phase Energy meter and LPF Wattmeter using Phantom loading and Verification with Trivector meter
8.	Measurement of Current and Voltage using CT and PT
9.	Measurement of Resistance using Wheatstone bridge and Kelvin double bridge
10.	Measurement of Inductance and Capacitance using Anderson's bridge and Schering bridge

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	grasp and perform the measurements of different physical parameters using transducers and realize the characteristics	Applying (K3), Manipulation (S2)
CO2	follow the measurement of various electrical quantities using instruments	Applying (K3), Imitation (S1)
CO3	determine the unknown resistance, capacitance and inductance using various bridge circuits proficiently	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	1	2		1	2	3		1	3	3
CO2	3	2	1	3	1	2		1	2	3		1	3	3
CO3	3	2	1	3	1	2		1	2	3		1	3	3

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

20EIL32-ANALOG INTEGRATED CIRCUITS LABORATORY

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**
Preamble	This course provides practical knowledge on Integrated circuits design for given specification. It enables to design and verify circuits using analog components and simulation software.						

List of Exercises / Experiments :

1.	Verification of IC741 as Voltage follower and scalar
2.	Opamp application: Inverting, Non inverting Amplifier
3.	Opamp application: Adder, Comparator
4.	Design of wave shaping circuits : integrator, differentiator
5.	Design of 3 bit Flash type Analog to Digital converter
6.	Design of 4 bit Digital to Analog converter
7.	Design of 555 Timer in Astable and Monostable Mode of Operation
8.	Verification of Phase Locked loop using NE565.
9.	Design of power supply using discrete components and trouble shooting
10.	Simulation of Opamp based Circuits Anadigam and Implementation in FPAA

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Software: Anadigm tool

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Design basic analog circuits using IC741	Applying(K3), Precision (S3)
CO2	Design linear, non linear, data converters and wave shaping circuits using operational amplifier	Applying(K3), Precision (S3)
CO3	Design circuits with IC555 timer, power supply and perform simulation with CAD 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	1	2		1	2	3		1	3	3
CO2	3	2	1	3	1	2		1	2	3		1	3	3
CO3	3	2	1	3	1	2		1	2	3		1	3	3

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

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

Preamble:	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.	
Unit -I	**Listening:**	**6**
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.		
Unit -II	**Reading:**	**6**
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.		
Unit -III	**Soft Skills:**	**6**
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.		
Unit -IV	**Writing:**	**6**
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.		
Unit -V	**Speaking:**	**6**
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”, 1st Edition, Cengage Learning, New Delhi, 2011.
2.	Bob Dignen, Steve Flinders and Simon Sweeney, “Professional English for Work and Life, English 365, Student’s Book 2”, 1st Edition, Cambridge University Press, New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
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 Engineeirng & 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:**	**9**
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:**	**9**
Human Begin 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:**	**9**
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:**	**9**
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:**	**9**
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: 45

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.	Understanding (K2)
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co–existence of Self and Body.	Understanding (K2)
CO3	understand 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.	Understanding (K2)
CO4	understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	Understanding (K2)
CO5	distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	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		3						
CO2								2						
CO3						1		3						
CO4								2						
CO5								3						

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

ASSESSMENT PATTERN - THEORY

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

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

20MAT41 - STATISTICS AND NUMERICAL METHODS

(Common to all Engineering and Technology Branches except ECE, CSE and IT)

Programme & Branch	**All BE/BTech branches except ECE, CSE and IT branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**BS**	**3**	**1**	**0**	**4**

Preamble	To impart knowledge in testing of samples, ANOVA and interpolation. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations and solve linear and ordinary differential equations.	
Unit - I	**Testing of Hypothesis:**	**9+3**
Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single proportion and difference of two sample proportions – Z-test for single mean and difference of means – Small sample tests: Student's t-test for testing significance of single mean and difference of means – F-test for comparison of variances – Chi-square test: Test of goodness of fit – Test of independence of attributes.		
Unit - II	**Design of Experiments:**	**9+3**
Introduction – Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design.		
Unit - III	**Solution to Algebraic and Transcendental Equations:**	**9+3**
Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.		
Unit - IV	**Interpolation, Numerical Differentiation and Integration::**	**9+3**
Interpolation: Interpolation with equal intervals: Newton‘s forward and backward difference formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula. Numerical Differentiation and Integration: Differentiation using Newton‘s forward, backward and divided difference formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule.		
Unit - V	**Numerical Solution of First order Ordinary Differential Equations:**	**9+3**
Single step methods: Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Veerarajan T, Ramachandran T., "Statistics and Numerical Methods", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.

REFERENCES:

1.	Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2012.
2.	Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.
3.	Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", 7th Edition, McGraw-Hill Education, 2014.
4.	Ravish R. Singh, Mukul Bhatt, "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply statistical tests for solving engineering problems involving small and large sample tests.	Applying (K3)
CO2	handle experimental data with the knowledge of ANOVA.	Applying (K3)
CO3	apply various numerical techniques to solve algebraic and transcendental equations	Applying (K3)
CO4	compute intermediate values of given data, numerical derivatives and integral values	Applying (K3)
CO5	obtain the solution of first ordinary differential equations by numerical methods.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20CSC41 PYTHON PROGRAMMING

Common to all BE/BTech Engineering and Technology branches except CSE,IT)

Programme& Branch	All 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**
Problem solving strategies – program design tools – Types of errors – Testing and Debugging- Basics: Literals – variables and identifiers – data types - input operation – comments – reserved words – indentation – Operators and Expressions – Decision Control Statements: Introduction – conditional statement – iterative statements – Nested Loops – break, continue and pass statements – else in loops.		
Unit- II	**Lists, Tuples and Dictionary:**	**9**
Lists:Access, update, nested, cloning, operations, methods , comprehensions, looping - Tuple:Create, utility, access, update, delete, operations, assignments, returning multiple values, nested tuples, index and count method - Dictionary: Create, access, add and modify, delete, sort, looping, nested, built-in methods – list vs tuple vs dictionary.		
Unit- III	**Strings and Regular Expressions:**	**9**
Strings:Concatenation , append, multiply on strings – Immutable – formatting operator – Built-in string methods and functions – slice operation – functions – operators – comparing – iterating – string module – Regular Expressions **–** match, search, sub, findall and finditer functions – flag options.		
Unit- IV	**Functions and Modules:**	**9**
Functions 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, 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

TEXTBOOK:

1	ReemaThareja., "Python Programming using problem solving approach", 3rd impression, Oxford University Press., New Delhi, 2017.

REFERENCES:

1	NageswaraRao, "Core Python Programming", 2nd Edition, DreamTech Press, New Delhi, 2018.
2	Jake Vander Plas ," Python Data Science Handbook Essential Tools for Working with Data", O'Reilly publishers,1st Edition,2016.

COURSEOUTCOMES: Oncompletionof thecourse, the studentswillbe ableto		**BT Mapped (HighestLevel)**
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)

MappingofCOswith POsandPSOs

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‘sTaxonomy														

ASSESSMENTPATTERN-THEORY

Test / Bloom’sCategory*	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%maybe varied (CAT 1,2,3–50 marks & ESE–100marks)**

20EIT41–INDUSTRIAL INSTRUMENTATION-I

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

Preamble	This course imparts the knowledge of instruments used for the measurement of Temperature and Pressure with their principles. It will also provide the methods for the measurement of Force, Torque, Velocity, Acceleration and Vibration.	
Unit - I	**Temperature Measurement I**	**9**
Physical Effects utilized to measure Temperature – Temperature Scales – Mechanical Thermometers: Filled system Thermometers – Metallic - Expansion Thermometers – Special Temperature Indicating Devices – Bulb Installations – Solid state temperature **sensors**		

Unit - II	**Temperature Measurement II**	**9**
Electrical Thermometers: Resistance Thermometers – Thermistors – Thermocouples – Radiation Pyrometers. Fiber -optic Temperature measurement systems – Ultrasonic Thermometers –Temperature switch.		
Unit - III	**Pressure Measurement I**	**9**
Units of pressure – Mechanical Pressure Measurement: Manometers – Elastic type pressure gauges: Bourdon type – Metallic Diaphragm – Capsule – Bellows. Electrical Methods of Pressure Measurement: Strain-Gauge – Capacitance – Potentiometric – Resonant Wire – Piezoelectric – Magnetic– Optical.		
Unit - IV	**Pressure Measurement II**	**9**
Vacuum sensors: Mechanical Vacuum Gauges: McLead gauge – Thermal Vacuum Gauges: Knudsen gauge – Pirani gauge – Thermocouple vacuum gauge – Ionisation Vacuum Gauges – Testing and Calibration of Pressure Detectors: Dead weight tester – **Pressure Switches**.		
Unit - V	**Force, Torque, Velocity, Acceleration and Vibration**	**9**
Force(Weight) Measurement: Mechanical balance – electromagnetic balance – mechanical load cells strain gauge type load cells – Torque Measurement: DC cradled dynamometer – proximity sensors – Speed and Velocity Measurements: Tachometers – induction type – magnetic type – eddy current type speed sensors – Acceleration Measurement: Seismic acceleration pickups – variable reluctance accelerometers –Vibration measurement: Mechanical vibration sensors		

Total:45

TEXT BOOK:

1	Krishnaswamy K. & Vijayachitra S. "Industrial Instrumentation", 2ndEdition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

1	Singh S. K., ‘Industrial Instrumentation and Control’, 3rd Edition, Mcgraw Hill Education India, New Delhi, 2017.
2	Patranabis D., ‘Principles of Industrial Instrumentation’, 3rd Edition, Mcgraw Hill Education India, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the theory and working behind temperature measurement and mechanical thermometers	Understanding (K2)
CO2	demonstrate the working of various types of electrical thermometers and determine the unknown temperature	Applying (K3)
CO3	demonstrate the construction and working of pressure measuring instruments for various industrial applications	Applying (K3)
CO4	explain the construction and working of vacuum measuring instruments	Understanding (K2)
CO5	illustrate the various measuring parameters such as force, torque, velocity, acceleration,	Applying (K3)

	vibration and shock for industrial applications	

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				1	2	2
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1						2				2	2	2
CO5	3	2	1	1	1			2				1	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	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

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

20EIT42–DIGITAL LOGIC CIRCUITS

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**ES**	**3**	**1**	**0**	**4**

Preamble	To impart the acquaintance about Boolean algebra, logic gates, combinational and sequential logic, logic families, memory and programmable logic devices	
Unit - I	**Boolean Algebra and Minimization Techniques**	**9+3**
Number systems and conversions **–** Boolean logic operations – Basic laws of Boolean Algebra – DeMorgan's theorems – Sum of Products and Product of Sums – Karnaugh Map (Two-variable, Three variable, Four-variable) – QuineMcCluskey or Tabular method of minimization of logic functions – Logic gates – Mixed logic – Multilevel gating networks		

Unit - II	Combinational Circuits	9+3

Procedure for the Design of Combinational circuits – Half adder – Full adder – Half subtractor – Full subtractor – Multiplexers: 4-to-1 and 8-to-1 Multiplexers, Implementation of Boolean expressions using multiplexers – Demultiplexers: 1-to-4 and 1-to-8 Demultiplexers – Decoders: 3-to-8 and 4-to-16 Decoders – Encoders: Octal-to-Binary Encoder – Parity Generators/Checkers – Parity generation – Code Converters: BCD-to-Binary converters, Binary-to-Gray code converters – Magnitude Comparators: Single bit Magnitude Comparator.

Unit - III	SynchronousSequentialCircuits	9+3

LatchesandFlip-flops: Latches – Flip-Flops – S-R, D, J-K and T Flip-flops - Triggering of Flip-flops- Master-Slave Flip-flops Realization of one Flip-flop using other Flip-flops - Synchronous Sequential Circuits: General sequential circuit model – Design of synchronous sequential circuits - State reductionand assignment - Analysis of synchronous sequential circuits –Design of synchronous counters:Designof MOD-3 counter - Registers: Universal shift registers.

Unit - IV	AsynchronousSequentialCircuits	9+3

Design of Fundamental mode asynchronous sequential circuits: Realization using D Flipflops, Realization using JK Flipflops - Problems in asynchronous circuits: Cycles, Races, Hazards –Design of hazard free switching circuits: Static, Dynamic and Essential hazards elimination – Asynchronous (Ripple or Serial) counter.

Unit - V	Logic Families and Memory	9+3

Logic Families: Introduction – Characteristics of Digital ICs: Speed of operation, Power dissipation, Fan-in, Fan-out, Noise immunity or noise margin - Transistor Transistor Logic (TTL): TTL NAND Gate – Emitter Coupled Logic (ECL): Inverter - Memory and Programmable Logic Devices: Introduction – Classification of memories – Basic memory structure - Read Only Memory (ROM) : Architecture of ROM, Types of ROM – Random Access Memory (RAM) : Types of RAM, Static RAM, Dynamic RAM - Introduction to PLA, PAL and FPGA.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1	Salivahanan S., & Arivazhagan S., "Digital Circuits and Design", 5th Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1	M. Morris R. Mano, & Michael D. Ciletti, “Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog”, 6th Edition, Pearson Education, New Delhi,2018.
2	AnandKumar A.,“FundamentalsofDigitalCircuits”,4thEdition,Prentice Hall of India, New Delhi,2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	simplify the boolean expressions	Applying(K3)
CO2	implement the combinational logic circuits	Applying(K3)
CO3	employ synchronous sequential logic for implementing digital circuits	Applying(K3)
CO4	implement digital circuits using asynchronous sequential logics	Applying(K3)
CO5	identify the role of logic families and memory devices	Understanding(K2)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1								3	3
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	40	50				100
CAT2	10	30	60				100
CAT3	15	65	20				100
ESE	15	35	50				100

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

20EIT43–ELECTRICAL MACHINES AND DRIVES

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

Preamble	To understand the construction, operation and behavior of various electrical machines used in real time application and also classifies the different types of starting and speed control techniques and its significance	
Unit - I	**DC Machines**	**9**
D.C. Generator: Construction of D.C. Machines –Working Principle – Types– E.M.F. Equation. D.C. Motor:Working Principle – Back E.M.F – Armature Torque – Losses –Characteristics of Shunt Motors – Characteristics of Series Motors. Speed Control of D.C. Shunt Motors – Necessity of D.C. Motor Starter – Types of D.C. Motor Starters: Three-Point Starter – Applications of D.C.		

Motors.		
Unit - II	**AC Machines**	**9**
Single Phase Transformer: Construction– Types– Working Principle – E.M.F. Equation of a Transformer – Voltage Transformation Ratio–Equivalent Circuit of a Loaded Transformer. Voltage Regulation – Open-Circuit Test – Short-Circuit Test –Losses in a Transformer – Efficiency of a Transformer. Introduction to Autotransformer. **Synchronous Motor:** Construction – Operating Principle – V and inverted V Curves for Synchronous Motor - Applications of Synchronous Motors.		
Unit - III	**Three-phase Induction Motor**	**9**
Construction – Slip-Ring Motors Versus Squirrel Cage Motors - Principle of Operation – Slip – Torque-slip Characteristics – No-load and blocked rotor tests - Methods of Starting 3-Phase Induction Motors. Speed Control of Induction Motors: Changing Number of Stator Poles –Line Frequency –Applied Voltage –Rotor Circuit Resistance.		
Unit - IV	**Single-Phase Induction Motors**	**9**
Single-Phase Induction Motor: Construction and working principle – Types – Applications of Single-Phase Motors:Split-Phase Induction Motor – Capacitor-Start Motor – Capacitor-Start Capacitor-Run Motor – Shaded-Pole Motor. **Special Machines**: Stepper Motor – Permanent-Magnet Stepper Motor – Variable-Reluctance Stepper Motor – Hybrid Stepper Motor – Servomechanism: D.C. Servomotors – A.C. Servomotor –Universal Motor – Brushless D.C. Motors.		
Unit - V	**Electric Drives**	**9**
Introduction - Classification of Electric Drives - Basic Elements of Electric Drive - Requirements of a Drive Motor - Power Losses and Heating of Electric Motors - Classes of Duty and Selection of Motor - Drives for Specific Applications - Phase Controlled Converter Fed DC Drives: Single Phase Drives - Half Wave Drives – Full Wave Drives. Braking of Electric Motors.		

Total:45

TEXT BOOK:

1	Mehta V.K. & Rohit Mehta "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.

REFERENCES:

1	Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)",2nd Edition, Tata McGraw-Hill, New York 2010.
2	TherajaB.L.& Theraja A.K, "A text book of Electrical Technology", Vol.II, S.Chand & Co.Ltd., Reprint-2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	exemplify the construction and operation of DC and AC Machines	Understanding (K2)
CO2	enumerate the performance characteristics of machines	Understanding (K2)
CO3	outline the starting and speed control techniques of electrical machines	Understanding (K2)
CO4	compare the construction and working principle of special electrical machines	Understanding (K2)
CO5	list the electrical machine suitable for real time applications	Applying (K3)

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

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

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

20EIL41–INSTRUMENTATION SYSTEM DESIGN LABORATORY

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**
Preamble	To design signal conditioning circuits for various instrumentation systems						

List of Exercises / Experiments :

1.	Design of instrumentation amplifiers
2.	Design of first order and second order active filters using operational amplifiers.

3.	Design of signal conditioning circuit for RTD
4.	Design of linearization circuit for Thermistor
5.	Design of signal conditioning circuit for strain gauge and load cell
6.	Design and analysis of response of PID controllers
7.	Design of multi voltage output SMPS
8.	Design of circuits for DATA acquisition and cloud storage
9.	Development of tank flow/level set up(with pump and reservoir pipeline with orifice plate, collecting tank sensor calibration with auto pump off)
10.	Preparation of piping and instrumentation diagram , documentation of instrumentation project and project scheduling

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory manual
2.	Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International Edition, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Design various signal conditioning circuits	Applying(K3), Precision (S3)
CO2	Design and analysis of controllers	Analyzing (K4), Precision (S3)
CO3	Preparation of project documentation	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	1	1	2		3		3		2	3	3
CO2	3	2	1	1	1	3		3		3		2	3	3
CO3	3	3	2	2	2	3		3		3		3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20EIL42– VIRTUAL INSTRUMENTATION LABORATORY

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**
Preamble	To get familiarize with LabVIEW programming tool and data acquisition systems to find solutions to real time applications.						

List of Exercises / Experiments:

1.	Programming with basic functions
2.	Programming with For Loop and While Loop

3.	Programming with Structures, Local and Global Variables
4.	Programming with Arrays and File I/O’s
5.	Programming with Clusters and Formula Node
6.	Acquisition and Analysis of Electrical parameters using NI DAQ Card
7.	Acquisition and Analysis of Temperature using NI DAQ Card
8.	Acquisition and Analysis of Digital and Analog signals Using NI-ELVIS
9.	Acquisition and Analysis of Real Time Images using NI-EVS
10.	Sensor interfacing and Data acquisition using MyRio

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
3.	http://www.ni.com/en-in.html

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	execute LabVIEW programs using various controls and function palettes	Applying(K3), Precision (S3)
CO2	acquire and analyze real time signals using DAQ systems	Applying(K3), Precision (S3)
CO3	develop models to solve real time problems	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	1	1	2		1	2	3		1	3	3
CO2	3	2	1	1	1	2		1	2	3		1	3	3
CO3	3	3	2	2	2	3		3	3	3		1	3	3

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**	**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.
2.	Lodish. H., Berk A., Zipurursky S.L., Matsudaria P., Baltimore D. and Darnell J., "Molecular Cell Biology", 4th Edition, Freeman Press, 2000.

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

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

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

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

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

20EIT51–CONTROL SYSTEMS

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	3	1	0	4

Preamble	This course provides the concepts of the mathematical modeling, response and stability analysis of linear systems in time and frequency domain	
Unit - I	**Mathematical Modeling:**	**9+3**
Open loop and closed loop systems-Derivation of transfer function models and state space models(phase variable): Electrical Systems and Mechanical Systems with single and two degree of freedom, Electromechanical Systems: DC Motor - conversion of state model to transfer function- Electrical Analogy of Mechanical Systems. Transfer function derivation using block diagram reduction and signal flow graphs.		
Unit - II	**Time response of systems:**	**9+3**
Poles, Zeros and System Response-Type and Order of System -Significance of Test Signals-Step response analysis and specifications of first order system and second order under damped System. Steady State Error and Error Constant –State Transition Matrix- time domain solutions of state models of second order systems withimpulse input using Laplace transform method.		
Unit - III	**Stability Analysis in Time Domain:**	**9+3**
Concepts of Stability - Pole Locations and Stability - Routh Hurwitz Criterion - Root Locus Technique: conditions – angle and magnitude criterion – root locus construction –design of control loop gain.		
Unit - IV	**Frequency Response of Systems:**	**9+3**
Concept of Frequency Response, Frequency Response Analysis: Bode Plot and Polar Plot-gain margin and phase margin-deriving transfer function model from bode plot-Stability analysis in Frequency Domain: Nyquist Stability Criterion.		
Unit - V	**Compensators and Controllers in time domain:**	**9+3**
Effect of addition of poles and zeros on second order system response and system stability - Need for Compensator - Ideal Compensation on Time Response: P, PI, PD and PID controller - Design procedure of Lag and Lead Compensator via Root Locus.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1	Norman S. Nise," Control Systems Engineering", 7th Edition , Wiley-India Publishers, New Delhi ,2017.

REFERENCES:

1	Nagrath I.J., Gopal M., “Control Systems Engineering”, 6th Edition, New Age International Pvt. Ltd., New Delhi,2017
2	Ogata K., “Modern Control Engineering”, 5th Edition, Pearson Education, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	derive mathematical models by identifying various components of the control system	Applying (K3)
CO2	analyze transient and steady state response of first and second order systems	Analyzing (K4)
CO3	examine the stability of the systems in time domain.	Analyzing (K4)
CO4	analyze the frequency response of the systems.	Analyzing (K4)
CO5	examine the performance of Compensators	Analyzing (K4)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20EIT52 – MICROPROCESSOR AND MICROCONTROLLER

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Logic Circuits	5	PC	3	0	0	3

Preamble	To get acquaintance with the architecture of 8085 processor and 8051 controller, apply the embedded programming concepts for interfacing peripherals with the controller and to understand the applications of microcontrollers.	
Unit - I	**8085 Microprocessor**	**9**
Introduction to 8085 Microprocessor-Architecture-Pin configuration-Interrupts–Instruction Set –Addressing Modes–Timing Diagrams–Memory Interfacing –Simple Assembly Language Programs for arithmetic operations.		
Unit - II	**8051 Microcontroller**	**9**
Introduction to 8051 Microcontroller- Architecture- Memory Organization- Special function registers – Program Counter – PSW register –Stack - Instruction set-Addressing modes.		
Unit - III	**8051 Programming**	**9**
I/O Ports – Timer (Mode 1) / Counter– Serial Communication - Interrupt (Timer, Serial communication) – Programming in Embedded C: I/O port programming- Timer programming-Counter programming-Serial port programming-Interrupt programming		
Unit - IV	**Peripheral Interfacing with 8051**	**9**
Programming in Embedded C: Keypad-LCD – Seven segment LED-Sensors- A/D and D/A converters- DC Motor -Stepper motor – Servo Motor		
Unit - V	**Applications of Microcontrollers**	**9**
Smart Card reader, Automated Meter Reading System, Washing machine, Speedometer, 3D printers, Healthcare monitoring systems (only block diagram approaches)		

Total:45

TEXT BOOK:

1	Muhammad Ali Mazidi, Janice Gillispie Mazidi, & Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, 2nd Edition, Fourth impression, Pearson Education, New Delhi, 2013.

REFERENCES:

1.	Soumitra Kumar Mandal, “Microprocessors and Microcontrollers Architecture Programming and System Design 8085,8086 and 8051”, 8th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi,2013.
2.	Senthil Kumar N., Saravanan M., & Jeevananthan S., “Microprocessor and Microcontroller”, 12th Impression, Oxford University Press, New Delhi,2015.
3.	Krishna Kant, “Microprocessors and Microcontrollers: Architecture, programming and system design 8085, 8086, 8051, 8096”, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic concepts of 8085 microprocessor	Understanding(K2)
CO2	summarize the basic concepts of 8051 microcontroller	Understanding(K2)
CO3	write embedded c programs for 8051	Applying(K3)
CO4	interface peripheral devices with 8051 microcontroller	Applying(K3)
CO5	recognize microcontroller based applications	Understanding(K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85					100
CAT2	10	45	45				100
CAT3	10	45	45				100
ESE	5	55	40				100

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

20EIT53 – INDUSTRIAL INSTRUMENTATION II

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Industrial Instrumentation-I**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course imparts the knowledge of instruments used for the measurement of flow and level with their principles. It will also provide the methods for the measurement of density, viscosity, humidity and moisture.	
Unit - I	**Flow Measurement I**	**9**
Mechanical Flow Meters – Orifice Flow Meter – Venturi Tubes – Flow Nozzle – Dall Tube – Installation of Head Flow Meters – Pitot Tube – Differential Pressure Transmitters - Quantity Meters -Inferential Flow Meters		
Unit - II	**Flow Measurement II**	**9**
Mass Flow Meters – Electrical Flow Meters: Electromagnetic Flow meter –Ultrasonic Flow Meters. Other Types of Flow Meters: Vortex Shedding Flow Meter – cross correlation flow meter. Solid flow Measurement – Flow Switches – Flow Meter Calibration – Flow Meter Selection		
Unit - III	**Level Measurement**	**9**
Float Type Level Measurement – Boiler Drum Level Measurement- Weight based Level Measurement – Air purge system – Electrical Methods: Resistance Tapes – Capacitance Probes – Radiometric Level Detection and Measurement –Ultrasonic Sensors – Level Switches.		
Unit - IV	**Density and Viscosity**	**9**
Measurement of Density: Displacement and Float Type Densitometers – Hydrostatic Densitometer – Ultrasonic and sonic densitometers – Radiation densitometers. Measurement of Viscosity: Capillary Viscometers – Efflux Cup Viscometers – Capillary Viscometer		
Unit - V	**Humidity and Moisture**	**9**
Measurement of Humidity: Dry and Wet bulb Psychrometers - Hair Hygrometers – Dew point Hygrometers - Electrolytic Hygrometers. Measurement of Moisture in Gases and Liquids: Piezoelectric Hygrometer - Infrared Absorption Hygrometer - Measurement of Moisture in Solids.		

Total:45

TEXT BOOK:

1	Krishnaswamy K., & Vijayachitra S., "Industrial Instrumentation", 2ndEdition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

1	Singh S. K., ‘Industrial Instrumentation and Control’, 3rd Edition, Mcgraw Hill Education India, New Delhi, 2017.
2	Patranabis D., ‘Principles of Industrial Instrumentation’, 3rd Edition, Mcgraw Hill Education India, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the flow rate using various types of mechanical flow meters	Applying(K3)
CO2	examine the flow through mass, electrical type flow meter, flow meter calibration, selection.	Applying(K3)
CO3	determine the fluid level using various types of level measuring instruments	Applying(K3)
CO4	illustrate the construction and working of density and viscosity measuring instruments	Understanding(K2)
CO5	interpret the construction and working of humidity and moisture measuring instruments	Understanding(K2)

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

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

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

20EIL51–ELECTRICAL MACHINES AND CONTROL LABORATORY

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	0	0	2	1
Preamble	To give practical exposure to the students to learn the characteristics of AC and DC machines and also to analyze the response of composite systems in time and frequency domain.						

List of Exercises / Experiments :

1.	No load and Load characteristics of DC shunt generator
2.	Load test on DC series motor
3.	Load test on squirrel cage induction motor
4.	Predetermination of efficiency and regulation on single phase transformer
5.	No load and load test on three phase alternator
6.	Transfer function of DC motor
7.	Time response of first and second order system
8.	State space analysis of second order systems using MATLAB
9.	Stability analysis in time and frequency domain using MATLAB
10.	Effect of P, PI and PID controller on time response

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the performance characteristics of DC and AC machines	Applying(K3), Precision (S3)
CO2	analyze the time and frequency response of first and second order systems	Analyzing(K4) Precision (S3)
CO3	analyze the stability of systems in time and frequency domain	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	3	1	2		1	2	3		1	1	3
CO2	3	3	2	3	2	2		1	2	3		1	2	3
CO3	3	3	2	3	2	2		1	2	3		1	2	3

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

20EIL52–MICROCONTROLLER AND INTERFACING LABORATORY

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**
Preamble	To design and develop interfacing circuits for 8051 microcontroller and microcontroller based instrumentation systems						

List of Exercises / Experiments :

1.	Arithmetic operations using 8085 microprocessor
2.	Embedded C Programming and interfacing using 8051 Microcontroller: Interfacing of switches and relays
3.	Interfacing of LED and seven segment LED
4.	Interfacing of Keypad and LCD
5.	Interfacing of ADC/DAC
6.	Interfacing of DC motor
7.	Interfacing of stepper motor
8.	Interfacing of servo motor
9.	Interfacing of different sensors for a given case study
10.	Design of simple closed loop applications using Microcontroller

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	LaboratoryManual
2.	Microcontroller Programming Software for 89c51 Microcontroller and Dumper kits.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the instructions in 8085	Applying(K3), Precision (S3)
CO2	design interfacing circuits with 8051 microcontroller	Applying(K3), Precision (S3)
CO3	develop microcontroller based systems for instrumentation applications	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	3	1	2		1	2	3		1	3	3
CO2	3	2	1	3	1	2		1	2	3		1	3	3
CO3	3	3	2	3	2	2		1	2	3		1	3	3

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

20EIL53- INDUSTRIAL INSTRUMENTATION LABORATORY

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**
Preamble	To measure various industrial parameters such as flow, level, temperature, and infer the characteristics						

List of Exercises / Experiments :

1.	Measurement of flow rate and comparison of the characteristics of the following flow meters. a) Orifice b) Venturi tube c) Electro Magnetic flow meters
2.	Measurement of flow rate and comparison of the characteristics of the following flow meters. a) Turbine Flow Meter b) Open Channel Weirs
3.	Calibration of Pressure Gauges with a) Forced Balance method b) Master Meter Method
4.	a) Measurement of torque and angle of the given cantilever beam b) Measurement of pH, Conductivity, Turbidity and TDS in different test samples
5.	Measurement of level in Linear and Non- Linear Tanks using a) Ultrasonic level Transmitter b) Differential Pressure Transmitter
6.	Measurement of a) Flow by flow switch b) Level by level switch
7.	Calibration of Safety Relief Valves and DPT with HART Communicator
8.	Calibration of Temperature switches and Pressure switches
9.	Measurement of non-electrical parameters of a person
10.	Measurement of Bio-potential parameters of a person

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Measure the physical quantities like flow, level, pressure and pH by selecting the suitable sensing elements	Applying(K3), Precision (S3)
CO2	Analyze the analytical parameters of samples using suitable analyzers	Analyzing (K4), Precision (S3)
CO3	Calibrate the pressure, temperature sensors and measure various bio medical parameters	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		2			1	3			3	3
CO2	3	3	2	3	1	2	2		1	3			3	3
CO3	3	2	1	3		2			1	3			3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

Programme & Branch	B.E. & Computer Science and 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	
Unit - I	**Soft Skills – I**	**20**
Soft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for change- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous knowledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business etiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone etiquette- Body Language.		
Unit - II	**Quantitative Aptitude & Logical Reasoning - I**	**30**
Problem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and variation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-Deductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement		
Unit - III	**Written Communication & Verbal Aptitude**	**30**
Writing Skills: Writing strategies and formats – Importance of Résumés – Writing a Cover letter – 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", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

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", 3rd 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)**

20EIT61 – PROCESS CONTROL

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Control Systems	6	PC	3	0	0	3

Preamble	This Course enhances the students to apply the concepts of process modeling with transfer function approach and empirical approach. The controller designs, tuning and final control elements with multi-loop control are discussed.	
Unit - I	**Process Modeling**	**9**
Need for automatic process Control - Process control terminology - Mathematical modeling of process: First order level, thermal and pressure process - Second order interacting and non-interacting systems: Liquid level process - Processes with inverse response: Boiler drum level control - Continuous and Batch process - Self regulation: CSTR with cooling jacket - Servo and Regulatory operations- Linearization of non-linear systems: Liquid level system.		
Unit - II	**Empirical Modeling**	**9**
Empirical modeling procedure - Graphical fitting of First-order models using step tests – Fitting of second-order models using step tests - Analysis of dynamic behavior in first and second order systems- Poles and Zeros and their effect on system response - Time delays - Approximation of Higher-Order Systems.		
Unit - III	**Controller Characteristics and Tuning**	**9**
Controller modes: Two position mode, Floating mode, proportional, integral and derivative modes, P+I, P+D, P+I+D modes- Electronic PID controller - Evaluation criteria. Controller Tuning: Process reaction curve method, Ziegler-Nichols method, Damped oscillation method, Relay tuning, Frequency response method of tuning: Bode plot method.		
Unit - IV	**Final Control Elements**	**9**
Signal conversions: I/P converter - Actuators: Electric and Pneumatic type -Valve positioner – Characteristics of control valves - Valve bodies - Control valve sizing - Cavitations and Flashing - Selection of control valves.		
Unit - V	**Multi-loop Control:**	**9**
Feed Forward control - Cascade control - Ratio control - Selective control systems - Split-Range control - Inferential control - Introduction to multivariable control. Case studies: Boiler, Reactor, Distillation Column.		

Total:45

TEXT BOOK:

1	Krishnaswamy K.," Process Control", 2nd Edition(Reprint), New Age International (P) Ltd., Publishers,New Delhi, 2015 for Unit 1,3,4 and 5.
2.	Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, and Francis J. Doyle, “Process Dynamics and Control”, 4th Edition, John Wiley and Sons, USA, 2016 for Unit 2.

REFERENCES:

1	Surekha Bhanot, “Process Control: Principles and Applications”, 4thEdition, Oxford University Press, United Kingdom, 2017.
2	Wayne Bequette. B,“Process Control: Modeling, Design, and Simulation”,2nd Edition, Prentice Hall of India, New Delhi 2013.
3.	George Stephanopoulos, “Chemical Process Control - An Introduction to Theory and Practice”, 2nd Edition, Prentice Hall of India, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	develop mathematical modeling for various processes	Applying (K3)
CO2	identify the real time models using empirical modeling	Applying (K3)
CO3	determine the optimum controller tuning methods for various applications	Applying (K3)
CO4	explain the control valve accessories and its operational characteristics	Understanding (K2)
CO5	apply the concepts of multi-loop control to various 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	1	1			2				1	3	3
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1						2				1	2	2
CO5	3	2	1	1	1			2				1	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	30	60				100
CAT2	10	30	60				100
CAT3	10	40	50				100
ESE	10	30	60				100

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

20EIT62 – DIGITAL SIGNAL PROCESSING

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Networks, Signals and Systems	6	PC	3	1	0	4

Preamble	To impart the fundamental knowledge and applications of Digital Signal Processing.	
Unit - I	**Discrete Time Signals and Systems:**	**9+3**
Motivation – Sampling and Quantization of signal – Discrete time (DT) sequences – Different representation of DT sequence – Operations on DT sequence – LTI system – Properties – Linear and circular convolution - Correlation.		
Unit - II	**Transforms:**	**9+3**
Z-transform for LTI system analysis – Discrete Fourier Transform – Properties – Fast Fourier Transform – Decimation in Time FFT algorithm – Decimation in Frequency FFT algorithm – Frequency response of LTI system.		
Unit - III	**FIR Filters:**	**9+3**
Characteristics, symmetry, linear phase and types – Design of FIR filter using windowing techniques (Rectangular, Hanning and Hamming) – Introduction to optimal FIR filter design – Realization of FIR filter.		
Unit - IV	**IIR Filters and Finite Word Length Effect:**	**9+3**
Design of analog prototype filter – Types of IIR filter – Frequency transformation – Impulse Invariant technique – Bilinear Transformation technique – Realization of IIR filter – Effect of coefficient quantization – Effect of round off noise in digital filters – Limit cycle due to round off and truncation.		
Unit - V	**Digital Signal Processor:**	**9+3**
Architecture and features of TMS 320C54X signal processor. Multirate Digital Signal Processing: Sampling rate conversion: upsampling, downsampling, interpolation and decimation – Sampling rate conversion by a factor I/D – Polyphase decomposition – Subband coding of speech signals.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1	Esakkirajan S., Veerakumar T., and Badri N Subudhi, "Digital Signal Processing",1st Edition, Tata McGraw hill, New Delhi,2021.

REFERENCES:

1	John G. Proakis & Dimitris G. Manolakis., "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson Prentice Hall, New Delhi, 2014.
2	Alan V. Oppenhiem & Ronald W. Schafer, "Discrete Time Signal Processing", 3rd Edition, Pearson, New Delhi, 2014.
3.	Salivahanan S. "Digital Signal Processing", 4th Edition, Tata McGraw Hill , New Delhi, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	examine the classifications of discrete time signal and systems	Applying (K3)
CO2	apply Z transform and Fourier transform to determine the frequency response of LTI discrete system	Applying (K3)
CO3	design and realize the FIR filters	Applying (K3)
CO4	design and realize the IIR filters	Applying (K3)
CO5	examine the architecture of digital signal processor and interpret the concepts of multirate signal processing	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1					2		1	3	3
CO2	3	2	1	1	1					2		1	3	3
CO3	3	2	1	1	1					2		1	3	3
CO4	3	2	1	1	1					2		1	3	3
CO5	3	3	2	2	2					2		1	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	5	20	75				100
CAT2	5	20	75				100
CAT3	5	20	75				100
ESE	10	10	80				100

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

20EIT63–LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Logic Circuits**	**6**	**PC**	**3**	**0**	**0**	**3**

Preamble	Industrial automation is the use of control devices such as PLC/DCS/SCADA etc. to control industrial processes without manual intervention. This course discusses the logic and control systems with its hardware and software modules for implementing monitoring and control systems	
Unit - I	**Programmable Logic Controllers (PLCs)**	**9**
Programmable Logic Controllers - Parts of a PLC - Principles of operation - PLCs versus Computers - PLC size and application – Discrete I/O modules – Analog I/O modules – Special I/O modules – The Central Processing Unit(CPU) –Memory types – Programming terminal devices – Human Machine Interfaces(HMIs). Basics of PLC Programming: Program scan – PLC programming languages - Entering the ladder diagram		
Unit - II	**PLC Programming**	**9**
Programming timers: On-Delay timer instruction – Off-Delay timer instruction – Retentive timer - Programming counters: Counter instructions – Up counter – Down counter – Cascading counters – Combining counter and timer functions - Program control instructions: Master control reset instruction – Jump instruction - Subroutine Functions. Data manipulation instructions: Data manipulation – Data compare instructions. Sequencer Instructions.		
Unit - III	**Distributed Control Systems**	**9**
Evolution of Distributed Control Systems: Emergence of the Distributed Control System architecture. Local control unit architecture: Basic elements of a microprocessor based controller – Functional blocks: An introduction. Security design issues for the local control unit: Redundant controller designs.		
Unit - IV	**DCS Operator Interfaces**	**9**
Operator interfaces: Introduction – Low level operator interface – High level operator interface: Architectural alternatives, Hardware elements in the operator interface, Operator displays. Engineering interfaces: Engineering interface requirements.		
Unit - V	**PLC and DCS Applications:**	**9**
Process control and Data Acquisition systems: Closed loop container filling process - ON/OFF liquid heating system- PLC control of a PID loop. DCS applications: Power Plants- Cement plants – Pulp and Paper plants – Introduction and architecture of SCADA.		

Total: 45

TEXT BOOK:

1	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition ,Tata McGraw Hill ,New Delhi, 2019.

REFERENCES:

1	Michael P.Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada 1986.
2	John W.Webb, Ronald A.Reis. “Programmable Logic Controllers: Principles and Applications”, 5th Edition, PHI Learning Pvt. Ltd., New Delhi, 2013.
3.	Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press, USA, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discriminate the hardware components and I/O modules of Programmable Logic Controllers	Analyzing(K4)
CO2	Analyze the different PLC programming instructions	Analyzing(K4)
CO3	describe the architecture of Distributed Control Systems	Understanding (K2)
CO4	choose the operator Interfaces and displays in DCS	Applying (K3)
CO5	apply PLC and DCS for select 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	3	2	2	2			1		2			3	3
CO2	3	3	2	2	2			1		2			3	3
CO3	3	1						1		1			2	2
CO4	3	2	1	1	1			1		1			3	3
CO5	3	2	1	1	1			1		1			3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

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

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

20EIL61–PROCESS CONTROL LABORATORY

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	0	0	2	1
Preamble	This laboratory gives a practical exposure to the students to analyze the characteristics of level, temperature, pressure and flow processes. Selected multi-loop control systems and characteristics of control valve are experimented.						

List of Exercises / Experiments :

1.	Mathematical modeling of non-interacting and interacting second order system
2.	Closed loop analysis of flow process with servo and regulatory control
3.	Closed loop analysis of temperature process with servo and regulatory control
4.	Closed loop analysis of pressure process with servo and regulatory control
5.	Tuning of controller parameters for temperature process
6.	Response of ratio control for the pressure process
7.	Response of feed forward control of liquid level system
8.	Response of Cascade control of Continuous Stirred Tank Reactor
9.	Characteristics of control valves (Quick opening valve, Linear valve, Equal percentage valve)
10.	Mathematical modeling of single conical tank system

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyze the response of different control schemes in process applications	Analyzing (K4), Precision (S3)
CO2	analyze the controller parameters for optimal control of temperature process	Analyzing (K4), Precision (S3)
CO3	demonstrate the characteristics of pneumatic control valve	Analyzing (K4), Precision (S3)

Mapping of COs with POs and PSOs

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

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

20EIL62–SIGNAL PROCESSING AND EMBEDDED SYSTEMS LABORATORY

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	0	0	2	1
Preamble	To implement the signal processing concepts and to construct a complete system using microcontrollers						

List of Exercises / Experiments:

1.	Convolution of discrete signals using MATLAB and DSP Processor
2.	Stability analysis of discrete time systems
3.	Spectral analysis of signals using Fourier transform
4.	Design of FIR low pass filters using windowing techniques and realization of its structures
5.	Design of IIR low pass filters and realization of its structures
6.	Study of architecture and memory organization of PIC18 microcontroller
7.	Design and Simulation of Combinational and Sequential Circuits
8.	Interface DC Motor and Stepper Motor with PIC18
9.	Elevator Control using PIC18
10.	Sensor Interfacing for Real Time Application

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	MATLAB, LabVIEW
2.	MPLAB IDE, Xilinx and Quartus Software
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyze discrete time signals and Systems	Applying(K3), Precision (S3)
CO2	design and realization of digital filters	Applying(K3), Precision (S3)
CO3	interface different peripherals and design microcontroller based embedded applications	Applying(K3), Precision (S3)

Mapping of COs with POs and PSOs

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

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

20EIL63–LOGIC AND DISTRIBUTED CONTROL SYSTEMS LABORATORY

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PE	0	0	2	1
Preamble	This course gives a practical exposure in controlling selected application with PLC, SCADA and DCS. Selected multi-loop control systems and VFD based control applications are demonstrated.						

List of Exercises / Experiments:

1.	PLC and SCADA applications with discrete I/Os.
2.	PLC and SCADA applications with analog I/Os.
3.	DCS applications with discrete I/Os and analog I/Os.
4.	Bottle filling and conveyor control systems using PLC
5.	Pneumatic stamping system using PLC and development of HMI interfacing with PLC
6.	Pressure and flow control system using DCS
7.	Level Control in Conical tank system using DCS
8.	Level Control in Cylindrical tank with Feedback and Cascade control systems using DCS
9.	3 Phase motor and Submersible pump control using VFD, PLC and HMI/ SCADA
10.	Interfacing PLCs with IoT/ PROFINET

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Demonstrate the basic applications with PLC, SCADA and DCS	Applying(K3),Precision (S3)
CO2	Control level in linear and non-linear systems with PLC and DCS	Analyzing (K4), Precision (S3)
CO3	Demonstrate the PLC and DCS based control of motors and pumps with VFD	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	3	1	2		1	2	3		1	3	3
CO2	3	3	2	3	2	2		1	2	3		1	3	3
CO3	3	3	2	3	2	2		1	2	3		1	3	3

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

20EIP61 - PROJECT WORK I

Programme & Branch	B.E&EIE	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	EC	0	0	4	2

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Characterization (A5) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Characterization (A5) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Characterization (A5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Characterization (A5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) Characterization (A5) 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	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

Total: 60

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

Programme & Branch	**B.E. & Computer Science and 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/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.		

Total: 80

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Develop the soft skills of learners to support them work efficiently in an organization as an 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)

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	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

ASSESSMENT PATTERN - THEORY

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

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

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", 1st Edition, McGraw Hill Education, Noida, 2013.

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

ASSESSMENT PATTERN - THEORY

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

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

20EIT71 - INDUSTRIAL DATA COMMUNICATION

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PC	3	0	0	3

Preamble	This theory course aims in imparting fundamental knowledge of analog and digital modulation techniques. It will provide the types of protocols used for the purpose of serial communication and industrial communication.	
Unit - I	**Modulation**	**9**
Need of modulation – Amplitude modulation and demodulation – Frequency modulation and demodulation – Shannon's sampling theorem – Pulse code modulation. Multiplexing: Frequency and Time division multiplexing. Digital modulation: Amplitude shift keying – Phase shift keying – Frequency shift keying		
Unit - II	**Serial Communication**	**9**
OSI reference model– Protocols, – RS-232 overview, RS-232 interface standard (CCITT V.24 interface standard)– Half-duplex operation of the RS-232 interface– Summary of EIA/TIA– 232 revisions, Limitations– RS-485 overview– The RS-485 interface standard– RS-485 Troubleshooting, RS-485 vs RS-422- RS-485 Installation– Noise problems– Test equipment– The 20 mA Current loop.		
Unit - III	**Communication Cable:Copper cable**	**9**
Characteristics– Cable selection – Coaxial cables– Twisted-pair cable – Distribution /installation standards– Connector standards. **Fibre optics Communication**: Fibre-optic cable components– Cable parameter– Types of optical fibre– Basic cable types– Connecting fibers		
Unit - IV	**Communication Protocols: Modbus**	**9**
Modbus Overview – Modbus protocol structure – Function codes -query response cycle, transmission mode– Message Formatting. **Profibus PA/DP/FMS :**Profibus protocol stack– The Profibus communication model– Relationship between application process and communication – Communication objects. **TCP/IP**- Internet layer protocols (packet transport) - Internet layer- The host-to-host layer - End to end reliability- 10 Mbps Ethernet -100 Mbps Ethernet -Gigabit Ethernet		
Unit - V	**Industrial communication: HART**	**9**
HART Introduction – HART and smart instrumentation – Physical layer, Data link and application layer **-** HART Commands – HART protocol problems **Foundation Field Bus**: Introduction - The Physical layer and Wiring Rules– The Data link layer– The Application layer– The User layer– Error detection and diagnostics - High-speed Ethernet (HSE)		

Total:45

TEXT BOOK:

1	Steve Mackay, Edwin Wright, & Deon Reynders, “ Practical Industrial Data Networks: Design, Installation and Troubleshooting” 1st Edition ,Elsevier,USA, 2004.

REFERENCES:

1	Wayne Tomasi, “Electronic Communication Systems: Fundamentals through Advanced”, 5th Edition, Pearson Education, New Delhi, 2013.
2	William L. Schweber, “Data Communications”, 1st Edition, Tata McGraw-Hill,New Delhi, 2009.
3	Ian Verhappen & Augusto Pereira, “Foundation Fieldbus”, 4th Edition, International Society of Automation,2012.
4	Forouzan, BehrouzA., “Data communication and Networking”, 4th Edition, Tata McGraw-Hill, New Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Summarize the concepts of types of modulation and demodulation and digital modulation	Understanding (K2)
CO2	Make use of the essentials of the communication system and learn the serial communication interface	Understanding (K2)
CO3	Interpret knowledge about Copper cable and fiber optic cable communication	Understanding (K2)
CO4	Examine the suitability of various communication protocols	Applying (K3)
CO5	Identify the applications of HART and Field bus	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1				1		1					2	2
CO2	3	1				1		1					2	2
CO3	3	1				1		1					2	2
CO4	3	2	1	1	1	1		1					3	3
CO5	3	2	1	1	1	1		1					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	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

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

20EIP71 - PROJECT WORK II PHASE- I

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	EC	0	0	12	6

Total: 180

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) 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	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

20EIP81 - PROJECT WORK II - Phase II

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	EC	0	0	8	4

Total: 120

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) 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	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3

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

20EIE01-BIOMEDICAL INSTRUMENTATION

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

Preamble	To impart the knowledge of some human anatomy and measuring bio potentials using bio electrodes with specific instruments which is most commonly used in hospitals. Also understand the fundamental concept of various biomedical imaging techniques and learn the advanced physiological assistive medical devices.	
Unit - I	**Human Physiological Systems**	**9**
Cell and its structure-Resting and action potentials - Skeletal system - Circulatory system - Components of the Bio medical instrumentation system. **Bio Potential Electrodes:** Micro electrode - depth and needle electrode - surface electrodes		
Unit - II	**Biomedical Electrical signal measurement**	**9**
ECG, EEG, EMG, ERG and EOG : Lead systems, recording methods and typical waveforms.		
Unit - III	**Biomedical Non Electrical signal measurement**	**9**
Digital stethoscope - Phonocardiography (PCG) - Blood pressure Measurement: Sphygmomanometer, MEMS based catheter tip pressure sensor, ultrasonic blood pressure monitor – Spirometer – Capnography - Blood pH measurement - Measurement of blood pCO2 - Blood pO2 measurement - Pulse oximeter - Lung volumes, respiration.		
Unit - IV	**Biomedical Imaging Systems**	**9**
X-ray machine - Computer tomography - Ultrasonic imaging systems - Magnetic resonance imaging - PET - SPECT - -FMRI – Magnetic Particle Imaging.		
Unit - V	**Physiological assist devices**	**9**
Ventricular asynchronous pacemaker - AC Debrillator- Heart lung machine - Kidney machine - Audiometer – Biothesiometry Vibroscreen - Ophthalmoscope –Biotelemetry - Telemedicine.		

Total:45

TEXT BOOK:

1	Khandpur R.S," Handbook of Biomedical Instrumentation", 2nd Edition,Tata McGraw-Hill ,New Delhi ,2012.

REFERENCES:

1	John G. Webster, “Medical Instrumentation Application and Design”, 4th Edition, John Wiley and Sons, NewYork, 2015.
2	Andrew G. Webb, “Principles of Biomedical Instrumentation” 1stEdition, Cambridge University Press, United Kingdom, 2018.
3	Arumugam. M, “Bio-Medical Instrumentation”, 2nd Edition, Anuradha Agencies, Kumbakonam, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the basic principles and phenomena of Biomedical Engineering	Understanding (K2)
CO2	record the bioelectric potentials using bio potential electrode through bio signal recording devices	Applying (K3)
CO3	measure biomedical signal parameters through medical instruments	Applying (K3)
CO4	summaries the basic principles in medical imaging techniques	Understanding (K2)
CO5	illustrate the physiological assist devices	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				2		1					2	2
CO2	3	2	1	1	1	2		1					3	3
CO3	3	2	1	1	1	2		1					3	3
CO4	3	1				2		1					2	2
CO5	3	2	1	1	1	2		1					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	28	28	44				100
CAT2	12	24	64				100
CAT3	24	32	44				100
ESE	24	32	44				100

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

20EIE02–EMBEDDED SYSTEMS

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

Preamble	To impart knowledge on the architecture of PIC18 microcontroller, apply assembly and embedded programming concepts to interface peripherals with the controller, introduce the basic concepts and building blocks of Embedded systems, RTOS and some case studies.	
Unit - I	**Introduction to PIC 18 Microcontrollers**	**9**
Architecture of PIC 18 – Pin Description – Memory Organization: Program Memory – Data Memory – Register Organization – Oscillator and Reset Circuits – Addressing Modes – Introduction to Instruction sets and C Programming.		
Unit - II	**PIC 18 Timer Programming**	**9**
Assembly Language/ C Programming to interface I/O Ports – Timers – Counters – Capture/Compare Mode – PWM**.**		
Unit - III	**Interfacing Peripherals with PIC 18 Microcontroller:**	**9**
Interfacing and Assembly Language/ C Programming of ADC – DAC – Temperature Sensor – LCD – Keyboard – DC motor - Stepper motor.		
Unit - IV	**Introduction to Embedded Systems**	**9**
Embedded Systems – Classification and examples of Embedded Systems – Design process in Embedded system – Challenges in Embedded System design –Functional building blocks of embedded systems – Structural units in Embedded processor – Selection of processor and memory devices – DMA – Timer and Counting devices – Watchdog Timer – Real Time Clock.		
Unit - V	**RTOS concepts and case studies**	**9**
Introduction to RTOS – Types of RTOSes – Tasks – Process – Task scheduling – Interprocess communication - Priority Inversion Problem. Case Studies: Automatic Chocolate Vending Machine – Smart Card Reader – Digital Camera.		

Total:45

TEXT BOOK:

1	Mazidi, Muhammad Ali, Rolin D. Mckinlay, and Danny Causey , "PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18", 1st Edition, Pearson Education, India, 2009.

REFERENCES:

1	Rajkamal, "Embedded Systems Architecture, Programming and Design", 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2015
2	Shibu. K.V, "Introduction to Embedded Systems", 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic concepts of PIC microcontroller and function of its hardware units	Understanding (K2)
CO2	write assembly/embedded programs to interface timers / counters with PIC microcontroller	Applying (K3)
CO3	develop assembly/embedded programs to interface peripherals with PIC microcontroller	Applying (K3)
CO4	interpret the basic concepts of embedded systems	Understanding (K2)
CO5	demonstrate the applications of embedded system using RTOS	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						1		1		1	2	2
CO2	3	2	1	1	1			1		1		1	3	3
CO3	3	2	1	1	1			1		1		1	3	3
CO4	3	1						1		1		1	2	2
CO5	3	1						1		1		1	2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	65	25				100
CAT2	10	30	60				100
CAT3	20	80	-				100
ESE	10	60	30				100

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

20EIE03 SOFT COMPUTING TECHNIQUES

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

Preamble	Emphasis of this course will be on Artificial Neural Networks, Fuzzy Logic, Meta-heuristic techniques like Genetic Algorithms and Neuro fuzzy Systems and their applications to different computational problems.	
Unit - I	**Artificial Neural Networks – An Introduction**	**9**
Fundamental Concept of Hard and Soft Computation – Evolution of Neural Networks – Basic models of Artificial Neural Network- Important Terminologies of ANNs - McCulloch Pitts Neuron – Linear Separability – Hebb Network - Perceptron Networks – Adaptive Linear Neuron – Solving Logical Functions using Neural network.		
Unit - II	**Feedforward Neural Networks**	**9**
Supervised Learning Network: Back Propagation Network - Radial Basis Function network- Associative Memory Network: Hopfield Networks – Discrete Hopfield Network. Unsupervised Learning Networks: Kohonen Self Organizing Map – Adaptive Resonance Theory Networks. Application of Neural Networks: Pattern Classification.		
Unit - III	**Fundamentals of Fuzzy Logic Systems**	**9**
Introduction to fuzzy logic –Classical sets (Crisp sets) - Fuzzy sets. Classical Relation and Fuzzy Relation: Introduction – Cartesian Product of Relation – Classical Relations – Fuzzy Relations – Tolerance and Equivalence Relations - Noninteractive Fuzzy Sets - Membership functions: Introduction – Features of the Membership Functions – Fuzzification – Methods of Membership Value Assignments.		
Unit - IV	**Fuzzy Inference Systems (FIS)**	**9**
Defuzzification: Introduction - Lambda-Cuts for fuzzy sets and fuzzy relations, Defuzzification methods. Fuzzy Rule Base and Approximate Reasoning: Introduction – Truth Values and Tables in Fuzzy Logic – Fuzzy Prepositions – Formation and Decomposition of Rules – Aggregation of Fuzzy Rules – Fuzzy Reasoning – Fuzzy Inference systems(FIS): Construction and Working Principle of FIS – Methods of FIS. Application of Fuzzy logic Controller: Aircraft landing problem.		
Unit - V	**Genetic Algorithm**	**9**
Introduction – Biological Background – Traditional Optimization and Search Techniques - Basic Terminologies in GA – Operators in GA – Problem solving using Genetic Algorithm: Maximizing a Function. **Neuro-Fuzzy System:** Characteristics of Neuro–Fuzzy Hybrids – Adaptive Neuro - Fuzzy Inference System(ANFIS).		

Total:45

TEXT BOOK:

1	Dr.S.N.Sivanandam & Dr.S.N.Deepa, “Principles of Soft Computing”, 3rd Edition, Wiley, New Delhi, 2018.

REFERENCES:

1	Laurene Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Pearson Education, 2nd Edition, 2001.
2	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, 3rd Edition, Wiley, New Delhi, 2010.
3	David E. Goldberg, “Genetic algorithms in search, optimization, and machine learning”, 3rd edition, Addison Wesley Longman Publishing Co, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the fundamentals and the concepts of artificial neural networks	Understanding (K2)
CO2	develop the various neural network algorithms for classification and function approximation	Applying(K3)
CO3	interpret the fuzzy logic concepts that deals with environment of uncertainty and imprecision	Understanding(K2)
CO4	design the Controller using Fuzzy Inference System	Applying (K3)
CO5	apply Genetic Algorithm and Neuro-Fuzzy concepts for specific applications	Applying (K3)

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

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

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

20EIE04 PIPING AND INSTRUMENTATION DIAGRAMS

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

Preamble	This course discusses the basic knowledge on Instrumentation standards and to make students familiarize with Instrumentation Symbols, Abbreviations and Identification of Instruments to create Piping and Instrumentation Diagrams for Process Industries	
Unit - I	**Instrument Symbols And Standards**	**9**
Instrumentation standards: Purpose, Industry codes and standards, Government Regulations - Application to Industries, Application to work activities - Application to classes of Instrumentation and to Instrument functions. **Identification Systems:** Identification System guidelines**:** Instrument Index – Multipoint, Multivariable and Multifunction devices – System Identification – Loop Identification number – Identification Letter Tables.		
Unit - II	**Graphic Symbol Systems**	**9**
Instrument Line symbols - Measurement and control devices - AND/OR function symbols – Discrete devices – Shared continuous devices – Shared On/Off devices - Multipoint, Multifunction, Multivariable devices and loops. Primary elements – Final control elements – Electrical schematic symbols.		
Unit - III	**Fundamentals of P&ID Development**	**9**
Identification of P&ID and its role in process industries - P&ID Development Activity- Anatomy of a P&ID Sheet - Title Block - Ownership Block - Reference Drawing Block - Revision Block - Comments Block - Main Body of a P&ID. **Pipes and Equipments:** Fluid Conductors: Pipes, Tubes, and Ducts - Pipe Identifiers - Pipe Symbol - Pipe Tag - Pipe fittings. Manual Valves and Automatic Valves - classification of valves – valve operators – Actuators – Tagging Automatic valves – valve positions. Heat Transfer units: Heat exchanger identifier – Heat exchanger identifier Symbol – Heat exchanger Tag - Heat exchanger P&ID.		
Unit - IV	**Instrumentation and Control System**	**9**
Fundamentals of Instrumentation and Control - ICSS System Technology - ICSS Elements - Basic Process Control System (BPCS) -Instruments on P&IDs - Instrument Identifier - Signals: Communication Between Instruments - Different Instrument Elements - Simple control loops - Level Control Loops -Pressure Control Loops -Temperature Control Loops - Composition Control Loops - Flow Control Loops.		
Unit - V	**Plant Interlocks and Alarms**	**9**
Introduction- Safety strategies – Concept of a SIS – SIS extent – Anatomy of a SIS: SIS Element Symbols, SIS Final Elements, SIS Logic – Showing Safety Instrumented Functions on P&IDs – Discrete Control – Alarm System: Anatomy of Alarm systems, Alarm requirements, Alarm system Symbology, Concept of ‘Common Alarm’.		

Total:45

TEXT BOOK:

1	Liptak B.G., “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Volume 3, 4th Edition , Chilton Book Co, CRC Press, United States, 2016 for Unit 1 and 2.
2	Moe Toghraei, “Piping and Instrumentation Diagram Development”, 1st Edition, Wiley-Blackwell, USA, 2019 for Unit 3,4 and 5.

REFERENCES:

1	Ernest E. Ludwig, “Applied Process Design for Chemical and Petrochemical Plants, Vol-I”, 4th Edition, Gulf Publishing Company, Houston, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Summarise the basics of Instrumentation standards and symbols.	Understanding (K2)
CO2	Identify the Instrument symbols and Function symbols for various elements.	Understanding (K2)
CO3	Interpret the symbols of pipes and various equipments in Process industry and recognize P&ID and its role in Process industry.	Understanding (K2)
CO4	Implement the Control concepts in Basic Process Systems and develop simple control loops	Applying (K3)
CO5	Develop the Safety Interlock Systems and Alarm Systems in Process Plants and equipments	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		2			2	2
CO2	3	1						1		2			2	2
CO3	3	1						1		2			2	2
CO4	3	2	1	1	1			1		2			3	3
CO5	3	2	1	1	1			1		2			3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

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

20EIE05- INDUSTRIAL ELECTRONICS AND DRIVES

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Electrical Machines and Drives	5	PE	3	0	0	3

Preamble	To impart the knowledge on Power semiconductor devices and their characteristics, Controlled rectifiers, Choppers, DC drives, Variable Frequency Drives and to understand the specific applications of different drives.	
Unit - I	**Introduction to Power semiconductor devices**	**9**
Classification of power semiconductors – Control characteristics of power devices – Types of power electronic circuits – Elements in the design of power electronics equipment – Thyristors : Operating principle – Behaviour under biased condition – Gate triggering – Commutation methods.		
Unit - II	**Controlled rectifiers**	**9**
Principle of phase controlled converter operation - Single phase full converter – Single phase dual converter – Single phase semiconverter - Three phase full converters – Three phase dual converters – Three phase semi converters – Inverting mode of a converter - Effect of source and load inductances.		
Unit - III	**Choppers and Inverters**	**9**
Principle of DC chopper - Step up and Step down Choppers – Classification of choppers - Quadrants of operation – Switching mode Regulators - Buck, Boost and Buck-Boost Regulators. **Introduction to Inverters:** Principle of Operation- Single phase bridge inverters.		
Unit - IV	**DC drives**	**9**
Basic characteristics of DC motors – Operating modes – Single phase semi converter and dual converter drives- Three phase half wave and full converter drives – Control modes - Power control, Regenerative brake control, Rheostatic brake control, Combined regenerative and rheostatic brake control. **Introduction to AC drives :** Introduction to Variable Frequency Drives.		
Unit - V	**Drives for specific applications**	**9**
Drive considerations for textile mills – Steel rolling mills – Cranes and Hoist Drives – Cement mills – Sugar mills- Paper mills.		

Total:45

TEXT BOOK:

1	Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, 4th Edition, Pearson Education, New Delhi, 2014 for Units 1,2,3 and 4.
2	Vedam Subrahmanyam,"Electric Drives-Concepts and Applications", 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2017 for Unit 5.

REFERENCES:

1	Moorthi V.R., “Power Electronics - Devices, Circuits and Industrial Applications”, Oxford university press, New Delhi, 1st edition, 2012.
2	Gopal K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, Reprint, New Delhi, -2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the fundamentals of power devices for industrial drives	Understanding(K2)
CO2	describe the various controlled rectifiers	Understanding(K2)
CO3	interpret the different types of choppers and their working	Understanding(K2)
CO4	develop different applications by choosing DC drives	Applying (K3)
CO5	select suitable drives for industrial applications	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1											2	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	15	85					100
CAT2	15	85					100
CAT3	10	45	45				100
ESE	5	75	20				100

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

20EIE06 ADVANCED CONTROL THEORY

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

Preamble	To understand and analyse the performance of linear and nonlinear system in state space domain with and without controllers.	
Unit - I	**State Space Analysis in Continuous domain**	**9**
Review of state variable representation and state variable models in continuous systems. Conversion from transfer function to various state space model – Conversion of state space to transfer function-Non-uniqueness of state model – Eigen values and eigen vectors - State transition matrix and its properties. Solutions of state equations — Free and forced responses.		
Unit - II	**State Feedback Controllers and Observers**	**9**
Controllability and observability – Relation between transfer function and state model - Effect of sampling time on controllability and observability - State feedback controllers. State estimators: Full and reduced order observer. Steady state error in state model-PI feedback controller- Deadbeat Observers- Dead beat Control.		
Unit - III	**Phase Plane Analysis**	**9**
Behaviour of non-linear systems, jump resonance, sub-harmonic oscillation- Singular points Phase plane analysis: Linear and nonlinear systems - Construction of phase portraits using isoclines- Limit cycle analysis.		
Unit - IV	**Describing function Analysis**	**9**
Typical non-linearities Describing Function of nonlinearities –Review of Nyquist criterion for linear system -Nyquist stability criteria for nonlinear system–Limit cycle oscillations- Accuracy of Describing Function method.		
Unit - V	**Lyapunov Stability Analysis**	**9**
Stability in the sense of Lyapunov - Second method of Lyapunov - Lyapunov stability analysis of linear time invariant systems and non linear system- Krasovski's theorem- Variable gradient method of generating Lyapunov functions. Lyapunov analysis for non autonomous systems.		

Total:45

TEXT BOOK:

1	Gopal M. "Digital Control and State Variable Methods", 4th Edition, Tata McGraw-Hill,New Delhi,2008 for Units 1 and 2.
2	Slotine & Li , "Applied Nonlinear Control",2nd Edition, Prentice Hall Publishers, USA, 1991 for Units 3,4 and 5.

REFERENCES:

1	Richard C. Dorf& Robert H.Bishop, "Modern Control Systems"12th Edition, Pearson Publication, NewJercy,2013.
2	Khalil, Hasan K., "Nonlinear Systems", 2nd edition, Prentice Hall, NewJercy,2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyse the time domain characterisitcs of continuos systems in state space domain	Analyzing (K4)
CO2	Design state feedback controllers and observers	Applying (K3)
CO3	Apply the concepts in the design of state feedback controllers and observers	Analyzing(K4)
CO4	Analyse the behaviour of nonlinear systems using describing function method	Analyzing(K4)
CO5	Analyse the stability of linear and nonlinear systems using Lyapunov stability method	Analyzing(K4)

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

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

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

20EIE07 ANALYTICAL INSTRUMENTATION

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

Preamble	Analytical Instrumentation provides qualitative and quantitative techniques for analysis in chemical, pharmaceutical, clinical, oil refineries and in pollution monitoring and control. The conventional and modern analytical techniques along with their principle, instrumentation and applications are included in the course.	
Unit - I	**Colorimeters and Spectrophotometers**	**9**
The Electromagnetic Spectrum–Laws relating to absorption of radiation–Ultraviolet and Visible Absorption Spectroscopy–Spectrophotometers: IR spectroscopy: Basic components of IR Spectrophotometers – Types of IR Spectrophotometers– FTIR spectrophotometers – Flame Photometers: Principle of Flame Photometers and Construction Details of Flame Photometers - Atomic Absorption Spectroscopy.		
Unit - II	**Chromatography and pH measurement**	**9**
Basic definitions – Gas chromatography – Liquid chromatography -Types of Liquid Chromatography – High Pressure Liquid Chromatography (HPLC). pH Meters: Principle of pH Measurement – Electrodes for pH measurement: Hydrogen electrodes – Glass electrodes – Reference electrodes – Combination electrode – Selective-ION Electrodes - Ammonia Electrode –Fluoride Electrode.		
Unit - III	**Industrial Gas Analyzers**	**9**
Types of gas analyzers – Paramagnetic oxygen analyzer –Electrochemical Methods- Infrared gas analyzers – Thermal conductivity analyzers - Analyzers based on Gas density ––Method based on Ionization of gases.		
Unit - IV	**Radio Chemical Techniques**	**9**
Fundamentals of radiochemical methods – Radiation detectors: Ionization chamber – Geiger-Muller counter – Proportional counter – Scintillation counter – Semiconductor detectors – X-ray spectrophotometer – Mass Spectrometers: Basic Mass Spectrometer-Principle of Operation – Types of Mass Spectrometers: Magnetic deflection mass spectrometer and the Time-of-flight mass spectrometer. NMR Spectrometer: Principle and construction details.		
Unit - V	**Applications of Analytical Instrumentation**	**9**
Scanning Electron Microscope, Scanning Probe Microscopes and Particle size analyzers. Air Pollution Monitoring Instruments: CO analyzer, SO_2analyzer, Ozone analyzer. Water Pollution Monitoring Instruments: Dissolved oxygen, oxidation-reduction potential, Turbidity meter.		

Total:45

TEXT BOOK:

1	Khandpur R.S., "Handbook of Analytical Instruments" 3rdEdition, McGraw-Hill Education India Pvt. Ltd, New Delhi ,2015.

REFERENCES:

1	Ewing G.W., "Instrumental Methods of Chemical Analysis", 6thEdition, McGraw-Hill, New York, 2007.
2	Douglas A. Skoog, F. James Holler, Stanley R. Crouh, "Principles of Instrumental Analysis", 6thEdition, Thomson Brooks Cole, San Francisco, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize on analytical instruments which utilize electromagnetic spectrum as source	Understanding (K2)
CO2	explain the chromatographic methods and electrodes used in pH measurement	Understanding(K2)
CO3	make use of analyzers for measuring industrial gases and liquids	Applying (K3)
CO4	interpret the sample data with radiochemical techniques	Understanding (K2)
CO5	apply analytical techniques for industrial requirements	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				2							2	2
CO2	3	1				2							2	2
CO3	3	2	1	1	1	2							3	3
CO4	3	1				2							2	2
CO5	3	2	1	1	1	2							3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80	-				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	4	57	39				100

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

20EIE08 INSTRUMENTATION SYSTEM DESIGN

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Process Control	7	PE	3	0	0	3

Preamble	To design controllers and signal conditioning circuits for instrumentation systems	
Unit - I	**SIGNAL CONDITIONING**	**9**
Analog Signal Conditioning: Introduction - Passive Circuits: Divider Circuits, Bridge Circuits - Op Amp Circuits In Instrumentation: Differential Instrumentation Amplifier, V-I Converter, I-V Converter, Integrator, Differentiator, Linearization. Digital Signal Conditioning : Introduction – Converters: Comparator, Digital to Analog Converters, Analog to Digital Converters - Data-Acquisition Systems: DAS Hardware, DAS Software		
Unit - II	**THERMAL SENSORS**	**9**
Introduction - Definition Of Temperature - Metal Resistance Versus Temperature Devices: Metal Resistance versus Temperature, Resistance versus Temperature Approximations – Resistance Temperature Detectors - Thermistors: Semiconductor Resistance versus Temperature, Thermistor Characteristics, -Thermocouples: Thermoelectric Effects , Thermocouple Characteristics, Thermocouple Sensors -Other Thermal Sensors: Solid-State Temperature Sensors - Design Considerations		
Unit - III	**FINAL CONTROL**	**9**
Introduction - Final Control Operation - Signal Conversions: Analog Electrical Signals, Digital Electrical Signals, Pneumatic Signals - Power Electronics: Switching Devices, Controlling Devices –Actuators: Electrical Actuators, Pneumatic Actuators, Hydraulic Actuators - Control Elements: Mechanical, Electrical, Fluid Valves.		
Unit - IV	**ANALOG CONTROLLERS**	**9**
Introduction - General Features - Electronic Controllers: Error Detector, Single Mode, Composite Mode - Pneumatic Controllers: General Features, Mode Implementation - Design Considerations		
Unit - V	**COMPUTER-BASED CONTROL**	**9**
Introduction - Digital Applications: Alarms, Two-Position Control - Computer-Based Controller: Hardware Configurations, Software Requirements - Other Computer Applications: Data Logging, Supervisory Control - Control System Networks: Development, General Characteristics, Field bus.		

Total: 45

TEXT BOOK:

1.	Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson Education Limited, London, 2015.

REFERENCES:

1.	Dale E Seborg ,”Process Dynamics and Control”, 3rd Edition, Wiley India, New Delhi, 2016.
2.	Surekha Bhanot, "Process Control: Principles and Applications", 4thEdition, Oxford University Press, United Kingdom, 2017.
3.	George Stephanopoulos, "Chemical Process Control - An Introduction to Theory and Practice", 2ndEdition, Prentice Hall of India, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	narrate the role of signal conditioning circuits in instrumentation	Understanding (K2)
CO2	develop signal conditioning circuits for temperature control system	Applying (K3)
CO3	design final control elements and actuators	Applying (K3)
CO4	design controllers for various applications	Applying (K3)
CO5	describe the role of computer based control systems	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	30	50				100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	20	20	60				100

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

20EIE09 DIGITAL IMAGE PROCESSING

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Signal Processing	7	PE	3	0	0	3

Preamble	To impart the fundamental knowledge and applications of Digital Image Processing.	
Unit - I	**Introduction to Image Processing**	**9**
Overview to Image Processing – Nature of Image Processing – Image Processing and Related Fields – Digital Image Representation – Types of Images – Fundamental Steps in Image Processing. **Digital Image Processing Operations:** Basic Relationships and Distance Metrics – Classification of Image Processing Operations – Arithmetic Operations: Image Addition, Image Subtraction, Image Multiplication, Image Division – Logical Operations: AND/NAND, OR/NOR, XOR/XNOR, NOT – Geometrical Operations: Translation, Scaling, Rotation – Image Interpolation Techniques – 2D Convolution and Correlation.		
Unit - II	**Image Transform**	**9**
Need for Image Transforms – 2D Discrete Fourier transform – 2D Discrete Cosine Transform – Haar Transform – SVD Transforms **Multiresolution Analysis:** Wavelet Transforms – Wavelet Scheme using Filters, Two-dimensional Wavelets. Case study: Image Decomposition and Reconstruction using Image Transforms.		
Unit - III	**Image Enhancement**	**9**
Image Quality and Need for Image Enhancement – Image Enhancement Point Operations – Linear and Non-linear Functions – Piecewise Linear Functions: Intensity Slicing, Bit-plane Slicing – Histogram Equalization – Spatial Filtering Concepts: Design of Discrete Gaussian Mask, Order-statistics Filters (Median, Maximum, Minimum) – Image Smoothing in Frequency Domain – Image Sharpening in Frequency Domain. **Image Morphology:** Need for Morphological Processing – Structuring Elements – Morphological Operations – Basic Morphological Algorithms: Boundary Extraction..		
Unit - IV	**Image Segmentation**	**9**
Introduction – Classification of Image Segmentation Algorithms – Detection of Discontinuities – Edge Detection: Stages in Edge Detection, Types of Edge Detectors – First-order Edge Detectors: Roberts Operator, Prewitt Operator, Sobel Operator – Second-order Derivatives Filters: Laplacian of Gaussian (Marr-Hildrith) Operator, Canny Edge Detection – Principle of Thresholding: Histogram and Thresholding, Global Thresholding Algorithms – Principle of Region-growing – Case study on Medical Image Segmentation.		
Unit - V	**Image Processing Applications**	**9**
Image Registration – Image Fusion – Image Mosaicking – Digital Watermarking – Theory and Case study		

Total:45

TEXT BOOK:

1	Sridhar S.,"Digital Image Processing", 2nd Edition, Oxford University Press, India, 2016.

REFERENCES:

1	Jayaraman S, Veerakumar T, Esakkirajan S. “Digital Image Processing”. 1st Edition, Tata McGraw Hill, New Delhi, 2009**.**
2	Tamal Bose. “Digital Signal and Image Processing”. Wiley, USA, 2004.
3	Rafael C. Gonzalez and Richard E. Woods. “Digital Image Processing”. Pearson, 4th edition, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic image processing operations	Understanding (K2)
CO2	apply various 2D transforms for images	Applying (K3)
CO3	interpret image enhancement techniques and morphological operations	Applying (K3)
CO4	examine various image segmentation algorithms	Applying (K3)
CO5	construct case study on image processing applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1						1		1			2	2
CO2	3	2	1	1	1			1		1			3	3
CO3	3	2	1	1	1			1		1			3	3
CO4	3	2	1	1	1			1		1			3	3
CO5	3	2	1	1	1			1		1			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	44	36				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20EIE10 POWER PLANT INSTRUMENTATION

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

Preamble	To provide an overview of various methods of power generation and the basic concepts and practical aspects of Instrumentation and Control in Thermal Power Plant and Nuclear Power plant.	
Unit - I	**Overview of Power Generation:**	**9**
Brief survey of Conventional and non-conventional methods of power generation – Nonconventional: Wind power – Solar power – Tidal Power – Geothermal Power – Magneto hydrodynamic Power - Fuel cells – Biomass Power. Conventional: Hydropower – Nuclear Power – Steam Power - Comparison of various power plants. Importance of Instrumentation and Control in power generation – Piping and Instrumentation diagram – Cogeneration of Power.		
Unit - II	**Instrumentation And Control In Water Circuit**	**9**
Water circuit – Boiler Feed water circulation: Forced circulation – combined circulation –Controls in water circuit: Boiler Drum Level Control – Super heated Steam temperature control – Steam pressure control. Impurities in water and Steam: Impurities in Raw water - Effect of impurities – Measurement of impurities.		
Unit - III	**Instrumentation And Control In Air-Fuel Circuit**	**9**
.Air-Fuel circuit – Measurements in air-fuel circuit – Controls in Air- Fuel circuit: Combustion control – Furnace draft control. Analytical Measurement: Oxygen measurement in Flue gas – Measurement of Carbon Dioxide in Flue gas – Combustibles Analyser (CO +H2) – Infrared Flue Gas Analysers – Smoke detector – Dust monitor – Closed circuit Television - Fuel Analysers – Chromatography.		
Unit - IV	**Power Plant Management**	**9**
Master control – Boiler Efficiency – Maintenance of Measuring Instruments – Interlocks for Boiler operation – Application of Distributed control system in Power Plants. **Turbine Monitoring and Control**: Turbine Steam inlet system – Turbine Measurements: Process parameters – Turbine control system: Safety control systems - Process control systems –Lubrication for Turbo-Alternator - Turbo-Alternator Cooling System.		
Unit - V	**Instrumentation and Control in Nuclear Power Plant**	**9**
Nuclear Power Plant components - Sensors and measurement system - Digital architectures in nuclear power plants – Reactor control: Pressurized Water Reactor (PWR) – Boiler Water Reactor (BWR) - Fast breeder reactor (FBR) - Radiation protection and monitoring – Nuclear reactor safety: Case study.		

Total:45

TEXT BOOK:

1	Krishnaswamy K.& PonniBala M., “Power Plant Instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd, New Delhi ,2013.

REFERENCES:

1	Swapan Basu, Ajay Debnath., “Power Plant Instrumentation and Control Handbook”, United States, 1st Edition, Academic Press Publications, 2014.
2	Philip Kiameh, Power Plant Instrumentation and Controls, 1st Edition, McGraw-Hill Professional, New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the knowledge about the basics of power plants and various methods of power generation	Understanding (K2)
CO2	infer the importance of Instrumentation and Control in Water circuit of Thermal Power Plant	Understanding (K2)
CO3	recognize various measurement and control techniques applied to Air- Fuel circuit of thermal power plant	Understanding (K2)
CO4	apply DCS, SCADA, Interlock circuits and turbine controls in Thermal Power Plant	Applying (K3)
CO5	develop the concepts of different Reactor controlled methods, safety and radiation measures in nuclear power plants	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20EIE11 WIRELESS INSTRUMENTATION

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

Preamble	To impart knowledge on wireless technology for instrumentation, wireless components and its applications. To provide adequate technical information on power sources, wireless protocols and network implementation.	
Unit - I	**Wireless Instrumentation Technology**	**9**
Introduction – Instruments and Instrumentation: Measurement systems – Multiplexing structures – Wireless instruments and communication protocols – RF interfaces and examples – Networks of wireless instruments – Sensor node components: Computing subsystem – Communication subsystem – Power subsystems – Sensing subsystems		
Unit - II	**Powering Autonomous sensors**	**9**
Autonomous sensors – Ambient energy sources and transducers – Energy storage units – Power considerations of wireless instruments – Energy harvesting: Solar and wind energy harvesting, RF energy harvesting, Energy harvesting from vibration, Thermal energy harvesting – Energy management techniques – Calculation for battery selection – Understanding RSSI and LQI values.		
Unit - III	**Wireless Systems/Standards for Automation**	**9**
Wireless HART: Protocol stack – Network components – Addressing control – Coexistence techniques. ISA100.11a: Introduction – Scope – Working group of ISA 100 – Features – Sensor classes – System configuration and architecture of ISA 100.11a – Comparison between ISA100.11a and WHART protocol stacks.		
Unit - IV	**Design of Wireless Devices**	**9**
Wireless sensor and instrument network design – Wireless integrated network sensors – Plug-and-play sensors and networks – Industrial wireless networks and automation. **LoRa:** Introduction – Communication Methods – Difference between LoRa and LoRaWAN – LoRaWAN architecture – LoRaWAN classes.		
Unit - V	**Wireless Sensor and Instrument Applications**	**9**
Application specific wireless sensors and instruments – Commercial wireless sensors and instruments – Industrial wireless sensor and instrument networks – Wireless human health monitoring and environmental applications – Radio frequency identification – Consumer products and other applications – Applications in Transportation and Agriculture.		

Total:45

TEXT BOOK:

1	John G. Webster, HalitEren, “Measurement, Instrumentation, and Sensors Handbook”, 2ndEdition, CRC Press - Taylor & Francis Group, LLC Boca Raton, Florida, 2017.

REFERENCES:

1	Subhas Chandra Mukhopadhyay, “Smart Sensors, Measurement and Instrumentation”, Springer Heidelberg, Germany, 2013.
2	Sunit Kumar Sen, “Fieldbus and Networking in Process Automation”, Taylor & Francis Group, LLC, London, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify different instrumentation systems and fundamentals of wireless technology	Understanding (K2)
CO2	indicate the power sources and energy storage units used for autonomous sensors	Understanding (K2)
CO3	recognize the different wireless protocols and network standards for wireless instruments	Understanding (K2)
CO4	illustrate design concepts and procedure for wireless devices and LoRA	Understanding (K2)
CO5	explore the various applications of wireless sensor and instrument systems and 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				1		1					2	2
CO2	3	1				1		1					2	2
CO3	3	1				1		1					2	2
CO4	3	1				1		1					2	2
CO5	3	1				1		1					2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	85					100
CAT2	15	85					100
CAT3	15	85					100
ESE	10	90					100

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

20EIE12 ADVANCED PID CONTROL

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Process Control	7	PE	3	0	0	3

Preamble	To provide an update of progress in many aspects of PID control research, development and industrial applications.	
Unit - I	**Process Models and PID control**	**9**
Review of process models: static, dynamic, step response, method of moments, frequency response, parameter estimation. Review of PID control: Feedback principle-Modifications of PID algorithm-Integrator windup-Digital implementation. PID controller design: Modified Zigler-Nichols method – Frequency domain method-Loop shaping- Optimization method-Pole placement method.		
Unit - II	**Controller architecture**	**9**
Ideal, classical, two degree of freedom. Self regulating and non-self regulating process models. **Controller tuning rules:** Controller tuning rules for self regulating process models: Delay, FOLPD, SOSPD, General. Controller tuning rules for non-self regulating process models:IPD,FOLIPD,I2PD,SOSIPD.		
Unit - III	**PID controllers for Integrating and Unstable systems**	**9**
Introduction to integrating and unstable system models- Integrating plus time delay systems-Unstable FOPTD and SOPTD system-CSTR model- Direct synthesis method -IMC method – Equating coefficient method-Set point weighting method.		
Unit - IV	**MIMO feedback systems**	**9**
PID tuning based on gain and phase margins-MIMO loop gain margins. **Mutivariable tuning methods:** Classification – parametric methods -non parametric methods- robustness measures-robust based PID design – sensitivity function-robust PID tuning rules.		
Unit - V	**Modern PID Control**	**9**
Characterization of all stabilizing PID controllers-Direct PID synthesis from frequency response data-Data based design Vs model based design- Event based PID control -Classifications- Data driven PID control- Industrial applications of PID control -Challenges and solutions-Chemical reactor-Distillation column-Evaporator.		

Total:45

TEXT BOOK:

1	Astrom K & Hagglund T "PID controllers: Theory, Design, and Tuning", 2nd Edition, Instrument Society of America, USA, 1995 for Units 1 and 2.
2	Ramon Vilanova,& Antonio visioli, "PID control in the third Millinneium", 1st Edition, Springer Verlag Ltd, London, 2012 for Unist 3,4 and 5.

REFERENCES:

1	Aidan O' Dwyer, "Handbook of PI,PID controller Tuning Rules", 3rd Edition, Imperial College Press,London,2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	develop fundamental process model and design PID controller	Applying (K3)
CO2	apply the controller tuning rules for different controller architecture	Applying (K3)
CO3	apply the concepts in the design of PID controllers for integrating and unstable systems	Applying (K3)
CO4	apply tuning rules for MIMO systems and Multivariable systems	Applying(K3)
CO5	recognize various modern PID control techniques applied to industrial applications	Understanding (K2)

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1			1		2			3	3
CO2	3	2	1	1	1			1		2			3	3
CO3	3	2	1	1	1			1		2			3	3
CO4	3	2	1	1	1			1		2			3	3
CO5	2	1						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	30	30	20			100
CAT2	20	30	30	20			100
CAT3	20	30	30	20			100
ESE	20	30	30	20			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.

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

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	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														

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

20EIE13 FIBER OPTICS AND LASER INSTRUMENTS

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

Preamble	The course will enable the students to learn about basic concepts and properties of optical fibers and lasers. The course will provide students with adequate knowledge about industrial application of optical fibers and lasers, holography and medical applications of lasers.	
Unit - I	**Optical Fibers and their Properties**	**9**
Ray theory transmission – Optical fibers – Preparation of optical fibers: Liquid-phase (melting) techniques, Vapor–phase deposition techniques – Transmission characteristics of optical Fibers: Attenuation, Material Absorption losses in silica glass fibers, Linear scattering losses, Dispersion, Chromatic dispersion, Intermodal dispersion, Overall fiber dispersion – Optical fiber connection: Fiber splices, Fiber connectors.		
Unit - II	**Industrial Applications of Optical Fibers**	**9**
Fiber optic sensor fundamentals – Intensity-modulated sensors – Phase-modulated sensors – Displacement sensors – Strain sensors – Temperature sensors – Pressure sensors – Magnetic and electric field sensors – Rotation rate sensors(Gyroscopes).		
Unit - III	**Laser Fundamentals**	**9**
Laser rate equations: Introduction, The two-level system, The three-level laser system, The four-level laser system – Pulsed operation of lasers: Q-switching, Mode locking – Properties of lasers: Laser beam characteristics – Laser safety: Physiological effects, Laser safety practices and standards		
Unit - IV	**Industrial Applications of Lasers**	**9**
Introduction – Applications in material processing: Laser welding, hole drilling, laser cutting – Laser tracking –Lidar – Precision length measurement – Laser interferometry: Homodyne and heterodyne interferometry – Velocity measurement : Lasers in information storage, Bar code scanner – Applications for surface treatment: Hardening, glazing, laser alloying, laser cladding.		
Unit - V	**Hologram and Medical Applications**	**9**
Principles of holography: Formation of holograms, The holographic process, Hologram types and efficiency – Applications of holography: Holographic interferometry – Light and matter: Reflection and refraction, Absorption, Scattering – Interaction mechanisms – Medical applications of lasers: Lasers in ophthalmology, Lasers in neurosurgery, Lasers in angioplasty and cardiology, Lasers in dermatology.		

Total:45

TEXT BOOK:

1	John.M. Senior, "Optical Fibre Communication – Principles and Practice", 3rd edition, Pearson Education India, New Delhi, 2010 for Unit 1.
2	David A. Krohn, Trevor W. MacDougall, &Alexis Mendez, "Fiber Optic Sensors: Fundamentals and Applications", 4th Edition, SPIE Press, Bellingham, 2015 for Unit 2.
3	Thyagarajan K, AjoyGhatak, "Lasers: Fundamentals and Applications' 2ndEdition, Springer Science & Business Media, New York, 2011 for Units 3, 4 and 5.

REFERENCES:

1	John F. Ready, "Industrial Applications of Lasers", 2nd Edition, Academic Press, San Diego, 1997.
2	Markolf H. Niemz, "Laser tissue interaction: Fundamentals and applications", 4th Edition, Springer science and business media, Switzerland, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	infer about the basics of optical fibres	Understanding (K2)
CO2	use fibre optic sensors for various industrial applications	Applying (K3)
CO3	interpret the working of various types of laser sources	Understanding (K2)
CO4	apply the laser based instrumentation systems for various applications in industries	Applying (K3)
CO5	predict the applications of lasers in medical field and holography	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	35	45	20				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

20EIE14 WEARABLE TECHNOLOGY

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

Preamble	A category of electronic devices that discuss the worn accessories, embedded in clothing, implanted in the user's body. The devices are hands-free gadgets with practical uses, powered by microprocessors and enhanced with the ability to send and receive data via the Internet.	
Unit - I	**Introduction to Wearable Technology**	**9**
An overview of wearable technology – Brief history – Applications of wearable Technology- Wearable Technology in Medicine and Health Care - Smart Glasses – Conventional Textile Wearable Integration Techniques.		
Unit - II	**Components and Technologies**	**9**
Introduction to components and technologies – Microprocessors and Microcontrollers – Operating Systems – Sensors – Wireless connectivity unit – Battery technology – Displays and other user interface elements – Microphones and Speakers. **Wearable Technologies and Force Myography for Healthcare:** Moving Monitoring – Accelerometers – Inertial Measurement Units - Data Gloves – Myography – Force Myography		
Unit - III	**Product Development and Design Considerations**	**9**
Introduction to Production development process – Engineering analysis – prototyping – Testing and validation – Production – Design considerations –Various factors and requirements – Operational power packing and material – Maintenance.		
Unit - IV	**Security Issues and Privacy Concerns**	**9**
Security issues – Privacy issues – Potential solutions – Product case examples: Blood Glucose Meters - Blood Pressure Monitors - Weighing and Body Analysis Scale - Pulse Oximeters – Electrocardiogram.		
Unit - V	**Psychological and Social Impact**	**9**
Psychological effects of wearable's – Social implications – Technology acceptance factors – Electromagnetic radiations – Specific absorption rate – Thermal effects. **Health Issues:** Cancers – Fertility – Vision and sleep disorder – Pain and discomfort – Electromagnetic intolerance and other risks.		

Total:45

TEXT BOOK:

1	Haider Raad, "The Wearable Technology Handbook", 1st Edition, United Scholars Publications, USA, 2017

REFERENCES:

1	Raymond Kai-Yu Tong ,"Wearable Technology in Medicine and Health Care", 1st Edition, Academic Press, United States,2018.
2	Fernando Jose Velez & Fardin Derogarian Miyandoab, "Wearable Technologies and Wireless Body Sensor Networks for Healthcare" ,1st Edition , The Institution of Engineering and Technology, United Kingdom, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	infer the recent technology used as wearable devices in medical and health care	Understanding (K2)
CO2	describe the functions, operations of various components and technologies in wearable devices	Understanding (K2)
CO3	analyze the development process and design consideration in wearable products	Applying (K3)
CO4	interpret the security and privacy issues in wearable technology	Understanding (K2)
CO5	explore the psychological and social impact, health concerns in wearable devices	Understanding (K2)

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

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

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

20EIE15 - DEEP NEURAL NETWOTKS FOR COMPUTATIONAL IMAGING

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

Preamble	This course will familiarize the students with computing techniques such as Neural networks, Deep learning and apply the above techniques to real world applications to get the desired optimal solution.	
Unit - I	**Applied Math and Machine Learning Basics**	**9**
The Math Behind Machine Learning: Linear Algebra and Statistics – Methods behind machine learning works – Logistic Regression, Evaluating models – Building an understanding of machine learning. **Fundamentals of Neural Network:** Neural Networks - Biological Neuron – The Perceptron – Multilayer Feed forward Networks – Back Propagation Learning.		
Unit - II	**Fundamentals of Deep Learning and Networks**	**9**
Activation Functions – Loss Functions – Hyper parameters. Deep Learning: Definition – Common Architectural Principles of Deep Networks – Building Blocks of Deep Networks: RBMs.		
Unit - III	**Major Architectures of Deep Networks**	**9**
Unsupervised Pretrained Networks: Deep Belief Networks – Generative Adversarial Networks – Convolutional Neural Networks (CNN): Convolution and Pooling as an Infinitely strong Prior - Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Recurrent Neural Networks.		
Unit - IV	**Review of Digital Image Processing**	**9**
Basic Relationship and Distance Matrix – Classification of Image Processing Operations – Arithmetic Operations – Geometric Operations – Image Interpolation Techniques – 2D Convolution and Correlation Operations. First Order Edge Detection Operators. Principle of Region Growing.		
Unit - V	**Applications of DNN**	**9**
Boundary Representations and Descriptions. Application of Deep Neural Networks on Computational Image Analysis (Case Study): Organ Detection, Segmentation and Image Classification – Evaluation of Classifier Algorithm.		

Total:45

TEXT BOOK:

1	Josh Patterson & Adam Gibson, "Deep Learning, A Practioner's Approach", 1st Edition, O'Reilley Media,Inc, USA, 2017 for Unit 1,2.3 and 5.
2	Sridhar S., "Digital Image Processing", Fourth Impression, Oxford University Press, New Delhi, 2013 for Units 4 and 5.

REFERENCES:

1	Ian Godfellow, Yoshua Bengio, & Aaron Courvillie, "Deep Learning", The MIT Press, Cambridge Massachusetts, 2nd Edition, 2016.
2	Gonzales R C,Woodsand R E, Eddins S L, "Digital Image Processing using MATLAB", Pearson Prentice Hall,Newyork,1st Edition,2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply basics of Linear Algebra and Statistics to machine learning and understand the fundamentals of Neural Network	Applying(K3)
CO2	explain the fundamentals of deep learning and networks	Understanding (K2)
CO3	summarize the major architectures of Deep Networks	Applying(K3)
CO4	solve various image processing operations	Applying(K3)
CO5	apply deep networks for computational image analysis	Applying(K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

20EIE16 INSTRUMENTATION TECHNIQUES IN AGRICULTURE

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Transducers Engineering**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To discuss the sensing and automation technology associated with agriculture.	
Unit - I	**Necessity of Instrumentation**	**9**
Necessity of instrumentation & control for agriculture and food processing requirement, World Agriculture Scenario, Indian Agriculture sector – A synoptic Review- Areas of Concern. Information, Interpretation and Instruction Systems – Agri Instrumentation. Introduction to Transducers – Characteristics.		
Unit - II	**Agri Transducers**	**9**
Technology Trend – Conventional and Silicon transducers, Capacitive gauges, Silicon Displacement transducer, Silicon Temperature transducer, Silicon Pressure Transducer. Grain Moisture transducers, soil moisture transducers, Humidity transducers, pH transducers, Gas transducers, Intelligent Sensors.		
Unit - III	**Processor Based Application**	**9**
Microprocessor based Grain moisture measurement- Introduction, Sensing Mechanism, I/O requirement analysis. Microprocessor based Soil Nutrient Estimation Systems- Soil nutrients and their role, collection of samples, soil nutrient estimation, sensing mechanism. Preparation of soil extract for estimation of N,P,K and S, I/O requirement Analysis. Supervisory control and Data Acquisition System (SCADA) – Introduction, SCADA system basic Signals, SCADA Functions.		
Unit - IV	**Drip Irrigation and Precision Agriculture**	**9**
: Introduction-Sensors, Hardware block Schematic, system operation, I/O Requirement Analysis, Hardware Systems. Precision: Introduction, need for precision agriculture. Subsystem and components- GPS, Agri sensors, DAS, Communication System. Precision agriculture status – Working Philosophy.		
Unit - V	**Green House Cultivation**	**9**
Designs and classification of greenhouse- Orientation of Greenhouse / Poly house- Components of green house- Plant growing structures/containers in green house production- Environmental factors influencing greenhouse cultivation- Media preparation and fumigation- Drip irrigation and fertigation systems greenhouse cultivation- Problem management in greenhouse cultivation		

Total:45

TEXT BOOK:

1	Krishna Kant , “Microprocessor Based Agri Instrumentation”, 1st Edition, PHI Private Limited, New Delhi, 2010.

REFERENCES:

1	Greenhouse Cultivation, Tamilnadu Agritech Portal. http://agritech.tnau.ac.in/horticulture/horti_Greenhouse%20cultivation.html
2	Sidney Walter Reginald Cox, Filby D E , “Instrumentation in Agriculture”, Lockwood Publishers, UK, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the necessity of instrumentation for agriculture	Understanding (K2)
CO2	familiarize with the Soil parameters and tranducers in agricultural instrumentation	Understanding (K2)
CO3	Illustrate the techniques of agriculture using Microprocessor and SCADA	Understanding (K2)
CO4	Outline the fundamentals of Drip Irrigation and Precision Agriculture	Understanding (K2)
CO5	Utilize the concepts of greenhouse cultivation in Agriculture	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	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	1											2	2
CO5	3	1											2	2

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	30	70					100

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

20EIE17 INDUSTRIAL INTERNET OF THINGS

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

Preamble	To transform the industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.	
Unit - I	**Introduction to Industrial IoT and Industry 4.0**	**9**
Introduction - IoT Background and History, IIoT key technologies, IoT and IIoT similarities and differences – Innovations and the IIoT – Intelligent devices – Key opportunities and benefits: Digital and human workforce – Industrial Internet use-cases - Industry 4.0: Characteristics and design principles.		
Unit - II	**IIoT Architectures**	**9**
IIoT Reference Architecture – Industrial Internet Architecture Framework – Five Functional domains – Three tier architecture topology – Connectivity: Key system characteristics, Connectivity security and functional characteristics – Functions of communication layer – Overview of Predictive Maintenance Architecture.		
Unit - III	**IIoT WAN Technologies and Protocols**	**9**
Need of Protocols – Legacy Industrial protocols – Modern Communication protocols: Industrial Ethernet, Encapsulated Field Bus, Standard Ethernet. IIoT device Low-Power WAN optimized technologies for M2M: SigFox, LoRaWAN, nWave, Dash7, Ingenue RPMA, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio.		
Unit - IV	**Industrial IoT Security and Governance**	**9**
Introduction – Security threats and vulnerabilities of IoT – Industrial challenges – Evolution of Cyber attacks: cyber attacks and solutions – Strategic principles of cyber security – cyber security measures - Industrial IoT security architecture: IIoT architecture patterns – four Tier IIoT security model- Management risks with IIoT.		
Unit - V	**Industrial IoT Analytics and Applications**	**9**
Software Defined Networks: Difference between SDN and NFV – Cloud and Fog - Big Data and Analytics in IIoT. Recent Technological components of Robots: Industrial Robotic applications – Industrial application of AR: Maintenance, assembly, operation and training – Additive Manufacturing: technologies, application areas of additive manufacturing.		

Total:45

TEXT BOOK:

1	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", 1st Edition, Apress Media, NewYork, 2016.

REFERENCES:

1	Alp Ustundag and EmreCevikcan, "Industry 4.0: Managing the Digital Transformation", Springer series in Advanced Manufacturing, Switzerland, 2018.
2	DimitriosSerpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems, Architectures, Algorithms, Methodologies", Springer International Publishing AG, Switzerland, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the basics of industrial internet of things	Remembering (K1)
CO2	interpret the concepts of various architectures and components	Understanding (K2)
CO3	design and implement protocols and sensors for IIoT	Applying (K3)
CO4	impart the knowledge of IIoT security layers	Understanding (K2)
CO5	apply IIoT in real time Industrial 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	2							1					1	1
CO2	3	1						1					2	2
CO3	3	2	1	1	1			1					3	3
CO4	3	1						1					2	2
CO5	3	2	1	1	1			1					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	15	85					100
CAT2	10	50	40				100
CAT3	5	35	60				100
ESE	10	50	40				100

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

20EIE18 OPTIMAL AND ADAPTIVE CONTROL

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Control Systems	7	PE	3	0	0	3

Preamble	To provide the knowledge about fundamental concepts of optimal and adaptive control techniques.	
Unit - I	**Introduction**	**9**
Matrix properties and definitions – Quadratic forms and definiteness – State space form for continuous systems. Calculus of variations: Fundamental concepts – The functionals of a single function- Optimal Control Formulation: The Performance measure: Performance measures for optimal control problems, selecting a performance measure. Constraints – Variational approach to optimal control problems: Necessary conditions for optimal control.		
Unit - II	**Linear Quadratic Optimal Control Systems**	**9**
Problem formulation – Linear regulator problem -Infinite time linear quadratic regulator – Meaningful interpretation of Riccati coefficient – Analytical solution of algebraic Riccati equation – Equivalence of open loop and closed loop. Design of LQR: Inverted pendulum, DC motor speed control.		
Unit - III	**Dynamic Programming**	**9**
The Optimal control law -Principle of optimality – Dynamic programming applied to routing problem – Recurrence relation of dynamic programming – Computational procedure for solving optimal control problems- Characteristics of dynamic programming solutions		
Unit - IV	**Self Tuning Regulators**	**9**
Introduction to adaptive control -classification -Pole placement design, Direct and Indirect self tuning regulators, continuous time self tuners, minimum variance and moving average controllers, stochastic direct and indirect self tuning regulators, linear quadratic self tuning regulators		
Unit - V	**Model Reference Adaptive control**	**9**
The MIT rule- Lyapunov theory - Design of model reference adaptive controller using MIT rule and Lyapunov theory - Relation between MRAS and STR, Introduction to Adaptive back stepping.		

Total: 45

TEXT BOOK:

1	Kirk, Donald E. “Optimal Control Theory: An Introduction” 1st Edition, Dover publications, USA, 2004 for Units 1,2 and 3.
2	Karl J Astrom and Bjorn Wittenmark, “Adaptive Control”, 2nd Edition, Addison Wesley, USA, 1995 for Units 4 and 5.

REFERENCES:

1	DesineniSubburam Naidu, “Optimal Control Systems” 1st Edition, CRC Press, London, 2002.
2	Rolf Isermann and Macro munchhof, “Identification of dynamic systems an introduction with applications”, 8th Edition, Springer Verlag,Berlin,2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate optimal control problem	Understand(K2)
CO2	apply the concepts in the design of optimal controller using LQR concepts	Applying (K3)
CO3	determine optimal control solution for discrete systems using dynamic programming	Applying (K3)
CO4	gain knowledge about the model reference adaptive control and self-tuning control systems	Understand(K2)
CO5	know the Implementation aspects of adaptive control 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	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	30	50	-			100
CAT2	10	40	30	20			100
CAT3	20	30	40	10			100
ESE	20	20	40	20			100

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

20EIE19 TOTAL QUALITY MANAGEMENT

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course deals with Quality concepts and TQM principles focusing on process quality to assure product quality to the customers. It also deals with the Basic and modern Quality management tools including ISO standards

Unit - I	**Quality Concepts and Principles:**	**9**
Quality Concepts and Principles: Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Basic concepts of Total Quality Management - Historical Review. Principles of TQM - Leadership –Concepts - Quality Council - Quality Statements - Strategic Planning - Deming Philosophy.		
Unit - II	**Total Quality Management-Principles and Strategies:**	**9**
Total Quality Management-Principles and Strategies: Customer satisfaction –Customer Perception of Quality - Customer Complaints - Customer Retention - Employee Involvement –Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal - Benefits. Continuous Process Improvement –Juran Trilogy - PDSA Cycle - 5S - Kaizen - Supplier Partnership –Partnering - sourcing - Supplier Selection - Supplier Rating - Relationship Development.		
Unit - III	**Control Charts for Process Control:**	**9**
Control Charts for Process Control: The seven tools of quality - Statistical Fundamentals –Measures of central Tendency and Dispersion - Population and Sample - Normal Curve - Control Charts for variables and attributes - Process capability - Concept of six sigma.		
Unit - IV	**TQM-Modern Tools:**	**9**
TQM-Modern Tools: The new seven tools of quality - Benchmarking-Need - Types and process; Quality Function Deployment-HOQ construction - case studies; Taguchi's Robust design-Quality loss function - DOE; Total Productive Maintenance-uptime enhancement; Failure Mode and Effect Analysis-Risk Priority Number.		
Unit - V	**Quality Systems:**	**9**
Quality Systems: Need for ISO 9000 and Other Quality Systems - ISO 9000 : 2015 Quality System –Elements - Implementation of Quality System - Documentation - Quality Auditing - Introduction to TS 16949 - QS 9000 - ISO 14000 - ISO 18000 - ISO 20000 - ISO 22000. Process of implementing ISO.		

Total:45

TEXT BOOK:

1	Dale H. Besterfield, "Total Quality Management", 3rd Edition, Pearson Education, New Delhi, 2011.

REFERENCES:

1	Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2008.
2	Feigenbaum A.V., "Total Quality Management", 4th Edition, Tata McGraw Hill , New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the need, history and principles of quality and TQM	Understanding(K2)
CO2	illustrate the principles and strategies of TQM	Understanding(K2)
CO3	make use of various tools and techniques of quality management	Applying (K3)
CO4	relate various quality tools and techniques in both manufacturing and service industry	Applying (K3)
CO5	explain the concepts of quality management system and ISO.	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	2	3	2	2	1	1	2	2
CO2	3	1				3	2	3	3	3	1	1	3	3
CO3	3	2	2	2	2	2		1	2	2	1	1	3	3
CO4	3	2	2	2	2	2		1	2	2	1	1	3	3
CO5	3	2				3	3	2	3	2	1	1	2	2

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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85					100
CAT2	15	45	40				100
CAT3	15	40	45				100
ESE	15	40	45				100

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

20EIE20 SAFETY IN PROCESS INDUSTRIES

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

Preamble	This course will provide the required information for safety management, prevention of accidents, hazard identification and control. It also discusses the risk analysis, management safety strategies, procedures and designs.	
Unit - I	**Safety Management**	**9**
Definitions – Safety Culture – Individual Risk, Societal Risk and Risk Populations – Safety Metrics – Accident and Loss Statistics – Risk Perception, Risk Tolerance/Acceptance and Risk Matrix – Safeguards. **Toxicology**: Effect of Toxicants on the Body – Toxicological Studies – Dose versus Response – Relative Toxicity – Threshold Limit Values.		
Unit - II	**Fires and Explosions**	**9**
The Fire Triangle – Distinction between Fires and Explosions – Flammability Characteristics of Liquids and Vapors – Sprays and Mists – Ignition Energy – Ignition Sources. Explosions: Detonation and Deflagration - Confined Explosions **Concepts to Prevent Fires and Explosions:** Inerting: Vacuum Purging, Pressure Purging.Explosion-Proof Equipment and Instruments – Ventilation – Sprinkler Systems.		
Unit - III	**Hazards Identification and Evaluation**	**9**
Introduction to Hazard Identification/ Evaluation and Risk Analysis – Non-Scenario-Based Hazard Identification/Evaluation Methods – Scenario-Based Hazard Identification/ Evaluation Methods – Documentation and Actions Required for Hazard Identification and Evaluation.		
Unit - IV	**Risk Analysis and Assessment**	**9**
Review of Probability Theory – Event Trees– Fault Trees – Bow-Tie Diagrams– Quantitative Risk Analysis– Layer of Protection Analysis – Risk Assessment.		
Unit - V	**Safety Strategies, Procedures, and Designs**	**9**
Process Safety Strategies – Safe Operating Procedures – Safe Work Practices – Designs for Process Safety – Designs for Runaway Reactions– Designs and Practices for the Safe Handling of Dusts.		

Total:45

TEXT BOOK:

1	Daniel A Crowl, & Joseph F Louvar ,“Chemical Process Safety (Fundamentals with Applications)”, 4th Edition, Pearson India 2019.

REFERENCES:

1	Amit Gupta, “Industrial Safety and Environment’, 2nd Edition, Laxmi Publication (P) Ltd., India, 2015.
2	www.osha.gov.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the fundamentals of safety management and toxicology	Understanding (K2)
CO2	interpret the concepts of fires and explosions and preventing fires and explosions	Understanding (K2)
CO3	summarize the methods of hazard identification/ evaluation	Understanding (K2)
CO4	choose suitable risk analysis and assessment techniques	Applying (K3)
CO5	integrate various safety strategies, procedures, and designs involved in process industries	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				2		1					2	2
CO2	3	1				2		1					2	2
CO3	3	1				2		1					2	2
CO4	3	2	1	1	1	2		1					3	3
CO5	3	2	1	1	1	2		1					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	30	70	-				100
CAT2	20	50	30				100
CAT3	-	40	60				100
ESE	20	40	40				100

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

20EIE21 VLSI SYSTEMS

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	To impart the knowledge on MOS transistor characteristics, fabrication, programming in Verilog Hardware Description Language and testing of ICs.	
Unit - I	**MOS Transistor Theory**	**9**
MOS Transistor Theory: NMOS enhancement transistor – PMOS enhancement transistor – Threshold voltage – Body effect.MOS transistor switches. Basic D.C. equations – Second order effects: Threshold voltage – Body effect – Sub threshold region –Channel length modulation – Mobility variation – Fowler- Nordheim tunneling – Drain punch through – Hot electron effect.		
Unit - II	**CMOS Logic and Circuit Design**:	**9**
CMOS Logic: Inverter – Combinational logic – NAND gate – NOR gate – Compound gates –Multiplexers – Memory – Latches and registers. Complementary CMOS inverter - DC characteristics – $\beta n/\beta p$ ratio, Noise margin. Switching characteristics: Fall time – Rise time – Delay time. Power dissipation for CMOS logic: Static dissipation – Dynamic dissipation – Short circuit dissipation. Layout design rules and Stick diagram for inverter, NAND and NOR.		
Unit - III	**CMOS Fabrication Technology:**	**9**
Basic CMOS technology: N-Well CMOS process – P-Well process – Twin tub process – Silicon on Insulator. Latchup: Physical origin of latchup – Latchup triggering – Latchup prevention – Internal latchup prevention techniques –I/O latchup prevention. FPGA: Programmable Logic – Programmable Logic structures – Programmable Interconnect – Xilinx Programmable Gate Arrays – Design flow.		
Unit - IV	**Verilog HDL:**	**9**
Typical design flow, Basic concepts: Lexical conventions – Data types, Modules and Ports, Gate level modeling, Dataflow modeling: Continuous assignment, Behavioral modeling: Structured procedure – Procedural assignments. Switch level modeling: MOS switches – CMOS switches – Bidirectional switches. Implementation of logic using Verilog HDL: Multiplexer, Comparator, D-Flip-Flop, Half Adder, Full Adder, Ripple Carry Adder, Arithmetic Logic Unit, Multiply and Accumulator Unit.		
Unit - V	**CMOS Testing and Verification:**	**9**
Introduction: Logic Verification, Debugging, Manufacturing Test- Manufacturing test principles: Fault Models , Observability, Controllability , Repeatability , Survivability , Fault Coverage Automatic Test Pattern Generation (ATPG). Design strategies for test: Built in Self Test (BIST).		

Total:45

TEXT BOOK:

1.	Neil Weste, & David Harris, “CMOS VLSI Design-A circuits & System Perspective” , 4th Edition, Pearson education, New Delhi,2017 for Units 1,2,3 and 5.
2.	Palnitkar Samir, " Verilog HDL: Guide to Digital Design and synthesis", 2nd Edition, Pearson Education, New Delhi, 2017 for Unit 4.

REFERENCES:

1.	Pucknell, Douglas A.,& Eshragian K., “Basic VLSI Design”, 3rd Edition, PHI Learning, New Delhi,2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the characteristics and the second order effects in designing MOSFET	Applying (K3)
CO2	discuss the CMOS logics and its characteristic for different logics	Applying (K3)
CO3	describe the various fabrication techniques for chip development	Applying (K3)
CO4	develop programming for VLSI systems using Verilog Hardware Description Language	Applying (K3)
CO5	explain the Testing process involved in chip design.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	20	50				100
CAT2	10	45	45				100
CAT3	10	45	45				100
ESE	10	40	50				100

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

20EIE22 MEMS AND NANO TECHNOLOGY

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

Preamble	The course aims to impart the knowledge on different materials, principles used for recent MEMS and NEMS fabrication techniques and applications.	
Unit - I	**Microsystems**	**9**
Overview of microelectronics manufacture and Microsystems technology– Scaling Laws In Miniaturization**:** Scaling in geometry – Scaling in rigid body dynamics – Scaling in electrostatic and electromagnetic forces – Scaling in Electricity - Scaling in Fluid Mechanic - Scaling in heat transfer – Materials for MEMS and Microsystems.		
Unit - II	**Micro sensors and Actuators**	**9**
Working principle of Microsystems – Micro actuation techniques – Micro actuators: Micro grippers - Miniature Microphones – Micro motors – Micro pumps – Micro valves – Micro accelerometers – Micro gyroscopes –Application of Microsystems in Automotive and Biomedical Field.		
Unit - III	**Microsystems fabrication and Manufacturing**	**9**
Substrates – Single crystal silicon wafer formation – Photolithography – Ion implantation – Diffusion –Oxidation - CVD – PVD – Deposition by epitaxy – Etching. Manufacturing process: Bulk Micromanufacturing - Surface Micromachining – LIGA –SLIGA. Microsystem Design Considerations.		
Unit - IV	**Introduction to Nanotechnology**	**9**
Carbon Allotropes – CNTs: Structure – Mechanical Properties– Electrical Properties – CNT Electronics – Synthesis – Graphene: Structure – Synthesis– Electrical Properties. Quantum Dots – Synthesis – Optical Properties – Single Electron Transistor – Quantum Dots in Medicine. Nanowires: Metal Nanowires – Semiconductor Nanowires.		
Unit - V	**Fields of Nanotechnology**	**9**
Scanning Tunneling Microscopy – AFM – Scanning Electron Microscopy– TEM. General Principles of Nano Fabrication – Fluid Flow in Submicrometer and Nanoscales – Heat Conduction at Nanoscale – Measurement of Thermal Conductivity–Nano Products – Application of Nanoproducts – Challenges in Nanoscale Engineering.		

Total:45

TEXT BOOK:

1	Tai-Ran Hsu, “MEMS and Microsystems: Design, Manufacture and Nano Scale Engineering”, 2ndEdition, John Wiley and Sons, New York, 2008.

REFERENCES:

1	Wesley C. Sanders, “Basic Principles of Nanotechnology”, 1st Edition, CRC Press, Taylor & Francis Group, New York, 2019.
2	Murty B.S., Shankar P., Baldev Raj, Rath, & James Murday, “Nanoscience and Nanotechnology”, Universities Press (India) Private Limited, Hyderabad, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	retrieve the concepts of scaling laws	Understanding (K2)
CO2	employ sensors and actuators in micro systems	Applying (K3)
CO3	interpret on the rudiments of micro fabrication techniques	Applying (K3)
CO4	interpret the properties of nanostructures and Nano synthesis	Applying (K3)
CO5	choose the nano-structured materials for engineering applications	Applying (K3)

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

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

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

20EIE23 INSTRUMENTATION IN AIRCRAFT NAVIGATION AND CONTROL

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

Preamble	To discuss the concepts of aircraft instruments and cockpit layout in modern aircraft and deals with the conventional and advanced flight instruments.	
Unit - I	**Basics of Aircraft and Aircraft Instruments**	**9**
Introduction – Control Surfaces – Forces – Moments and Angle of Attack – Engines – Avionics – Modern Aircraft System. Aircraft Instruments and their Layout – Aircraft Display Types – Quantitative and Qualitative Display – Instrument Grouping – Basic T Grouping, Glass Cockpits of Modern Aircraft.		
Unit - II	**Air Data Instruments and Directional Systems**	**9**
Introduction to Air Data Instruments – Pitot pressure and Pitot tube – Types of Air Data Instruments – Pneumatic-type Air Data Instruments – Air Speed Indicator, Air Data Computer – International Standard Atmosphere – Air Data Instruments – Directional Systems: Magnetic Compass – Earth Magnetic Field – Flux Detector Unit.		
Unit - III	**Gyroscopic and Advanced Flight Instruments**	**9**
Introduction – Types of Gyro – Conventional Mechanical, Vibrating Gyros, RLG, FOG – Basic Mechanical Gyro and its Properties – Directional Gyro and limitations – Gyro Horizon – Turn and Bank Indicator – Turn Coordinator – Standby Attitude Director Indicator Advanced Direction Indicators.		
Unit - IV	**Engine Instruments and Indicators**	**9**
Introduction – Engine Speed Measurements – Electrical Tacho Generator/Indicator, Servo Type, Non-Contact Type, Optical Tachometer, Hall Effect Sensor – Torque Measurements – Electronic Torque Meter – Pressure Measurements – Engine Pressure Ratio Indicator. Engine Fuel Indicators: Fuel Quantity Indicator.		
Unit - V	**Aircraft Navigation and Safety Warning Systems**	**9**
Introduction – Radio Navigation Aids – VHF Omni Directional Range System DME/ILS/INS/GPS – Principle of VOR operation – Distance Measuring Equipment, Instrument Landing Systems –Inertial Navigation System: Principle, Gimballed and Strap Down INS – Global Positioning System. Air Data Warning Systems.		

Total: 45

TEXT BOOK:

1	Nagabhushana S, & Sudha L K.. “Aircraft Instrumentation and Systems”, 2nd Edition, I.K. International Publishing House Pvt. Ltd.New Delhi, 2013.

REFERENCES:

1	Federal Aviation Administration (FAA), “Instrument Flying Handbook”, 1st Edition, Aviation Supplies and Academics, Washington, 2013.
2	Megson T M G., “Aircraft Structures for Engineering Students”, 4th Edition, Elsevier Science and Technology, Great Britain, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	infer the basics of aircraft and aircraft instruments	Understanding (K2)
CO2	discuss about air data instruments and directional systems	Understanding (K2)
CO3	make use of gyroscopes for advanced flight instruments	Applying (K3)
CO4	outline the fundamentals of engine instruments and indicators	Understanding (K2)
CO5	utilize the concepts of aircraft navigation safety warning 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	1											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1	1	1	1								2	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	90					100
CAT2	10	50	40				100
CAT3	5	60	35				100
ESE	8	62	30				100

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

20EIE24 MACHINE LEARNING AND ITS APPLICATIONS

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

Preamble	This course is intended to provide the foundation on topics in probability and various statistical methods which form the basis for many other areas in the mathematical sciences including parametric methods and decision theory. As application of machine learning case studies will also be addressed.	
Unit - I	**Machine Learning Basic Concepts**	**9**
Learning Associations – Classification – Regression – Unsupervised Learning – Reinforcement Learning. Supervised Learning: Learning Multiple Classes - Model Selection and Generalization. Bayesian Decision Theory: Introduction – Classification - Losses and Risks – Discriminant Function.		
Unit - II	**Dimensionality Reduction, Clustering and Decision Trees**	**9**
Introduction – Subset Selection – Principal Component Analysis – Factor Analysis – Multidimensional Scaling – Linear Discriminate Analysis. Clustering : Introduction – Mixture Densities – K-means Clustering .Decision Trees: Univariate Trees - Pruning – Multivariate Trees.		
Unit - III	**Multilayer Perceptrons**	**9**
Introduction – The Perceptron - Training a Perceptron – Learning Boolean Function – Multilayer Perceptrons - MLP as a Universal Approximator – Back Propagation Algorithm – Training Procedures - Tuning the Network Size – Bayesian View of Learning – Learning Time: Time Delay Neural Networks – Recurrent Networks.		
Unit - IV	**Local and Graphical Models**	**9**
Local Models: Introduction – Competitive Learning– Normalized and Competitive Basis Function – Learning Vector Quantization. Graphical Models: Canonical cases for conditional independence – Example of Graphical Models. **Reinforcement Learning:** Introduction – Elements of Reinforcement Learning – Model Based Learning - Temporal Difference Learning – Generalization.		
Unit - V	**Applications of Machine Learning**	**9**
Clustering: Analysis for Market Research -Regression: Predicting house prices with regression. Classification: Music Genre Classification – Computer vision.		

Total:45

TEXT BOOK:

1	Ethem Alpaydin, "Introduction to Machine Learning ",3rd Edition, The MIT Press, London, England ,2014

REFERENCES:

1	Luis Pedro Coelho, Willi Richert, "Building Machine Learning Systems with Python" 2nd Edition Packt Publishing, England, 2015.
2	Tom M.Mitchelll, "Machine Learning" 1st Edition, McGraw-Hill Education, New York, 1997.
3	James A Anderson, "An Introduction to Neural Networks", 1stEdition, MIT Press, UK,1995.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	infer the basic concepts of learning methods involved in machine learning	Understanding (K2)
CO2	explain the fundamentals of dimensionality reduction, clustering and decision trees	Understanding (K2)
CO3	summarize the concepts of neural networks along with its architectures	Applying(K3)
CO4	explain the various models and reinforcement learning techniques	Understanding (K2)
CO5	apply machine learning algorithms for basic clustering, classification and regression 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	1											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

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

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

20EIE25 CONTROL SYSTEM COMPONENTS

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Control Systems	7	PE	3	0	0	3

Preamble	To emphasize the engineering principles and fundamental characteristics of components and to explain their functions in composite systems	
Unit - I	**Mechanical Components**	**9**
Control system parameters- CAM: Components- Classification-CAM profile-CAM as a mechanical function generator-3D CAM. Gears: Types – Gears for load matching- Backlash in gears-Manufacture of gears. Gyroscope: Gyroscopic effect- Construction-Precession and velocity of precession-Generalised equations- Application.		
Unit - II	**Electromechanical Components**	**9**
Potentiometer: Types – Applications -Selection. Synchros: Construction and operation – Characteristics – Application - Synchro pair as error detector. Relays: Classification -Relay circuits – Construction-Characteristics of electromechanical and reed relays - Relay problems and remedies.		
Unit - III	**Actuators: Servomotors**	**9**
Theory of operation and transfer function of DC servomotors and AC servomotors. Stepper motor: Types – Construction and working – Driver circuits – Applications. **Tachogenerators:** Characteristic requirements – EMF equation - Commutation and armature reaction problem- AC induction tachogenerators-Working - Sources of errors- Applications		
Unit - IV	**Amplifiers and Modulators**	**9**
Rotating amplifiers: Types – Amplidyne generator- Working principle –transfer function. Magnetic amplifiers: Series connected - Parallel connected- Magnetic amplifiers with feedback. Servo amplifiers: Features – AC and DC servo amplifiers - Performance characteristics. Modulators and demodulators: Amplitude modulation theory- Half and full wave balanced modulator- Amplitude modulator circuit.		
Unit - V	**Hydraulic systems**	**9**
Components – Classifications- Hydraulic pumps - Hydraulic transmission lines- Hydraulic power supply. Hydraulic valves: Spool type- Nozzle valve- Flapper valve- Pulsed operation of control valves. **Pneumatic systems**: Pneumatic power supply – Compressor efficiency - Accessories for air compressor- Flow control. Pneumatic control valves: Operating mechanism – Direction control valves-P,PI and PID pneumatic control valves.		

Total:45

TEXT BOOK:

1	Desai M.D. “Control System Components”, 1st Edition, PHI learning Pvt Ltd, NewDelhi, 2008.

REFERENCES:

1	Gibson J.E. & Tuteur F.B. “Control System Components”,1st Edition, McGraw Hill, Newyork,2013.
2	Andrew W. G. &. William H.B, “Applied Instrumentation In The Process Industries”,2nd Edition, Gulf Professional, Houston,1979.
3	Liptak. B.G, “Instrument Engineers’ Handbook”,4thEdition,CRC Press,USA,2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	recognize the working and applications of mechanical components used for measuring angular displacement	Applying (K3)
CO2	distinguish the working and applications of electric mechanical components used for measuring angular displacement	Applying (K3)
CO3	identify the suitable actuators used for closed loop control system applications	Applying (K3)
CO4	recognize the working and applications of amplifiers used for composite systems	Applying(K3)
CO5	realize the working and applications of pneumatic and hydraulic components used in control 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	1	1					1			3	3
CO2	3	2	1	1	1					1			3	3
CO3	3	2	1	1	1					1			3	3
CO4	3	2	1	1	1					1			3	3
CO5	3	2	1	1	1					1			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	30	30	40				100
CAT2	30	30	40				100
CAT3	30	30	40				100
ESE	30	30	40				100

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

20EIE26 MULTISENSOR AND DATA FUSION

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Signal Processing	7	PE	3	0	0	3

Preamble	To impart the fundamental knowledge and applications of data fusion and implementation of data fusion algorithms	
Unit - I	**Sensor and Data Fusion**	**9**
Introductions, Sensors and Sensor data. Use of multiple sensors, Fusion applications. The inference hierarchy: Output data. Data fusion model: Architectural concepts and issues – Benefits of data fusion.		
Unit - II	**Data Registration**	**9**
Introduction - Registration Problem - Review of existing research - Registration using Meta-Heuristics - Wavelet-based registration of Range Images - Registration Assistance/Preprocessing - Registration using Elastic Transformations - Theoretical Bounds.		
Unit - III	**Principles of Image and Spatial Data Fusion**	**9**
Introduction - Motivation for combining image and spatial data - Defining image and spatial data fusion - Three classic levels of combination for Multisensor Automatic Target - Image data fusion for Enhancement of Imagery data - Spatial data fusion applications - Spatial data fusion GEOINT.		
Unit - IV	**Identity Declaration**	**9**
Identity declaration and pattern recognition - Future extraction - Parametric Templates - Cluster Analysis Techniques - Adaptive Neural Networks - Physical Models - Knowledge-based Methods - Hybrid Techniques.		
Unit - V	**Implementation of Data Fusion**	**9**
Introduction - Requirements Analysis and Definition - Sensor Selection and Evaluation - Functional Allocation and Decomposition - Architecture Trade-Offs - Algorithm Selection - Database Definition - HCI design - Software Implementation - Test and Evaluation - Survey on Military Applications.		

Total: 45

TEXT BOOK:

1	David L. hall, Sonya A.H. McMullen, “Mathematical techniques in Multisensor data fusion”, 2nd Edition, Artech House, Boston, 2004 for Units 1, 4 and 5.
2.	Martin E. liggins, David L. Hall and James Llinas, “Handbook of Multisensor Data Fusion: Theory and Practice” , 2nd Edition, CRC Press, Boca Raton 2009 for Units 2 and 3.

REFERENCES:

1	Brooks R. R. and Iyengar S. S., “Multisensor Fusion: Fundamentals and Applications with software”, 1st Edition, Prentice Hall Inc., New Jersey, 1998.
2	Jitendra R. Raol, “Date Fusion Mathematics, Theory and Practice”, 1st Edition, CRC Press, Boca Raton, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the basics concepts of sensor and data fusion	Understanding (K2)
CO2	illustrate the data registration for data fusion	Applying (K3)
CO3	examine the principles of image and spatial data fusion	Applying (K3)
CO4	explain the various techniques in data fusion	Understanding (K2)
CO5	implement the data fusion algorithm for realtime applications	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	44	36				**100**
CAT2	10	20	70				**100**
CAT3	20	44	36				**100**
ESE	10	30	60				**100**

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

20EIE27 ELECTRONIC INSTRUMENTATION

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

Preamble	To provide fundamentals of the Electronic Instruments in the field of Instrumentation Engineering. It discusses the concepts of digital instruments, signal generators, display devices and calibration.	
Unit - I	**Digital Instruments**	**9**
Block diagram of Digital Instrument-Digital Voltmeters: Dual slope Integrating type -Digital Multimeters-True RMS Meter-Digital Frequency meter-Digital Measurement of Time- Universal counter-Decade counter- Generalized Data Acquisition System (DAS).		
Unit - II	**Measuring Instruments**	**9**
Output Power meters-Field strength meter-Stroboscope-Phase meter-Vector Impedance meter: Direct Reading, Commercial vector Impedance meter-Rx meters-Automatic Bridges.		
Unit - III	**Signal Generators**	**9**
Introduction – Fixed Frequency AF Oscillator– Variable AF Oscillator - Basic Standard Signal Generator (Sine Wave)– Modern Laboratory Signal Generator - AF Sine and Square Wave Generator – Function Generator– Square and Pulse Generator (Laboratory Type)- Random Noise Generator- Sweep Generator.		
Unit - IV	**Display Devices**	**9**
Displays-Classification-LED & LCD-LCOS-Bar graph display-Segmental and Dot matrix display-Plasma Display-OLED-FOLED-simple CRO.		
Unit - V	**Instrument Calibration**	**9**
Introduction-Comparison methods- Digital multimeters as standard Instruments-Calibration instruments-Potentiometers-Potentiometer calibration methods-Multifunction calibrators-Multiproduct calibrators-Automated calibration.		

Total:45

TEXT BOOK:

1	Kalsi H.S. "Electronic Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCES:

1	David A Bell, Electronic Instrumentation and Measurements, Oxford University Press, New Delhi,2003.
2	Betty Lincoln, "Digital Electronics", 1st Edition, Pearson Education ,New Delhi,2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the fundamentals of digital instruments in various measurements	Understanding (K2)
CO2	employ the functions of measuring instruments	Applying(K3)
CO3	make use of various instruments to generate the waveforms	Applying (K3)
CO4	infer the types of displays used in electronics instruments	Understanding (K2)
CO5	illustrate the calibration methods for standard instruments	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	30	30				100
CAT2	50	20	30				100
CAT3	40	60					100
ESE	40	60					100

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

20EIE28 ARTIFICIAL INTELLIGENCE

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

Preamble	It is a broad discipline that promises to simulate numerous innate human skills such as automatic programming, case-based reasoning, natural language processing, pattern recognition and speech recognition etc. There is a thrust in using learning approaches to build new solutions in many real world applications.	
Unit - I	**Overview of Artificial Intelligence**	**9**
Introduction – The History of Artificial Intelligence. Intelligent Agents: Introduction - Structure of Intelligent Agents. Problem Solving: Problem - Solving Agents - Formulating problems.		
Unit - II	**Problem Solving and Informed Search Methods**	**9**
Searching for Solutions – Search Strategies: Breadth - first search – Uniform cost search – Depth - First search. Informed Search Methods: Best-First Search – Heuristic Functions – Memory bounded search – Game Playing: Perfect Decisions in Two - Person Games – Alpha – Beta Pruning.		
Unit - III	**Knowledge and Reasoning**	**9**
A Knowledge - Based Agent – Representation, Reasoning and Logic – Prepositional Logic – First Order Logic: Syntax and Semantics - Extensions and Notational Variations. Logical Reasoning Systems: Introduction – Indexing, Retrieval and Unification. Planning: Basic Representations for Planning.		
Unit - IV	**Learning in Neural and Belief Networks**	**9**
Neural Networks – Perceptrons – Multilayer Feed-forward Networks – Applications of Neural Networks – Bayesian Methods for Learning Belief Networks. Reinforcement Learning: Passive Learning in a Known Environment – Generalization in Reinforcement Learning.		
Unit - V	**Applications of Artificial Intelligence**	**9**
Perception: Image formation - Image – Processing operation for Early Vision. Robotics: Tasks – Parts – Architectures – Configuration Spaces – Navigation and Motor Planning		

Total:45

TEXT BOOK:

1	Stuart J.Russell & Peter Norvig , “Artificial Intelligence – A Modern Approach”, 1st Edition, Prentice Hall ,New Jersey, 2009.

REFERENCES:

1	Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", 2nd Edition, Morgan Kaufmann Publishers, Inc, San Francisco, California, 2000.
2	Elaine Rich & Kevin Knight, “Artificial Intelligence, 2nd Edition, Tata McGraw-Hill, NewYork, United States, 2008.
3	George F. Luger, “Artificial Intelligence-Structures and Strategies for Complex Problem Solving”, 6th Edition, Pearson Education, University of New Mexico, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the concept of artificial intelligence and impart knowledge on the fundamental concept	Understanding (K2)
CO2	develop an ability to understand the problem solving and informed search systems	Applying(K3)
CO3	interpret the knowledge based agents and reasoning logic involved in it	Understanding(K2)
CO4	comprehend the learning concepts involed in neural and belief networks	Applying (K3)
CO5	apply the artificial intelligence concepts in select 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	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	45	35				100
CAT2	25	45	30				100
CAT3	15	40	45				100
ESE	25	45	30				100

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

20EIE29 INSTRUMENTATION AND CONTROL IN PROCESS INDUSTRIES

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial Instrumentation, Process Control**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides the concepts of various processes in process Industries such as process, paper, steel, dairy products, pharmaceutical and fermentation. This course emphasizes the Instrumentation and Control techniques	
Unit - I	**Basics of Process Measurements**	**9**
Continuous vs. discrete measurement – Continuous vs. Sampled measurement – In-line, On-line and Off-line – Measurement uncertainty – Measurement decision risk –Calibration – Measurement device components – Current loop – Power supply and Wiring –Serial communications – Smart transmitters.		
Unit - II	**Instrumentation and control in Paper Industries**	**9**
Process description in diagrammatic and functional block details – Digester blow tank controls – Digester liquor feed pump control – Brown stock washer level control – Stock chest level control – Dissolving tank density control – White liquor classifier density control –White liquor flow control – Dryer temperature control		
Unit - III	**Instrumentation and control in Steel Industries**	**9**
Process description in diagrammatic and functional block details – Raw materials preparation – Operation of Blast Furnace (BF)– Basic Oxygen Furnace (BOF) – Electric Furnace (EF) – Open Hearth Furnace (OHF) – Gas and water control system in Basic oxygen furnace–Mold level control system in strand casting operation		
Unit - IV	**Instrumentation and control in Dairy Industries**	**9**
Process description in diagrammatic and functional block details–Plate heat exchanger – Single stage and Two stage Homogenizer – Doppler ultrasonic flow meter –Air operated milk valve– Control system in HTST pasteurizer– Temperature control in spray dryer– Automation for Cleaning in Place (CIP)-Metal detection system – Refrigeration System.		
Unit – V	**Instrumentation and control in Pharmaceutical and Fermentation Industries**	**9**
Description of the penicillin production process – flow measurement – Level measurement – Pressure measurement – Temperature measurement – Fermentation control system – Continuous fermentation – pH control – Temperature control – Centrifuge purging control.		

Total:45

TEXT BOOK:

1	Liptak B.G, “Instrumentation in the Processing Industries”, 1st Edition, Chilton Book Company, Boston, 1973.(Digitized 2008) for Unit 1,2,3 and 5.
2	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124105 Metal Detection - Dairy Knowledge Portal https://www.dairyknowledge.in › default › files for Unit 4.

REFERENCES:

1	Cecil Smith, “Basic Process Measurements”, 1st Edition, John Wiley & Sons, New Jersey, 2009.
2	Gosta Bylund, “Dairy Processing Hand Book”, 3rdEdition, Tetrapak Processing Systems, Sweden, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basics of process measurements in various industries	Understanding (K2)
CO2	develop the instrumentation and control systems in paper industry	Applying (K3)
CO3	build the instrumentation and control techniques involved in iron and steel industry	Applying (K3)
CO4	apply the various instrumentation and control schemes in dairy industry	Applying (K3)
CO5	interpret the knowledge on instruments used in pharmaceutical and fermentation industry	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	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	40	50				100
CAT2	10	30	60				100
CAT3	10	40	50				100
ESE	10	40	50				100

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

20EIE30 INTELLIGENT ROBOTIC SYSTEMS

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course aims to impart the knowledge in designing automatic manufacturing systems with robotic control using the principle behind robotic drive system, end effectors, sensor, robot kinematics.	
Unit - I	**Fundamentals of Robotics**	**9**
A brief history of Robotics – Robot Anatomy: Polar – Cylindrical – Cartesian Coordinate – Joint–arm Configuration – Work Volume – Robot Drive Systems: Hydraulic – Electric: Stepper Motor, Servo Motor – Pneumatic – Power Transmission Systems. Control systems: Limited sequence – Play Back with Point to Point – Continuous Path Control – Intelligent Robots. Precision of movement: Spatial Resolution – Accuracy – Repeatability – Compliance – Robotic Sensors – Robot Programming and Work cell control – Robot applications.		
Unit - II	**Sensors and Actuators**	**9**
End Effectors: Types of End Effectors: Mechanical Gripper: Vacuum Cups – Magnetic Grippers – Adhesive Gripper – Hooks and Scoops – Tools as End Effectors. – Robot/ End–Effectors Interface – Consideration in Gripper Selection And Design. Robotic Sensors: Transducers and Sensors – Sensors in Robotics: Position and Velocity Sensor – Tactile – Proximity and Range Sensors – Slip Sensors – Force and Torque Sensors – Miscellaneous Sensors and Sensor Based Systems.		
Unit - III	**Programming of Robots**	**9**
Robot Methods of Programming: Lead through Programming Methods – Robot Program as a path in space – Motion Interpolation – WAIT, SIGNAL and DELAY Commands – Branching – Capabilities and limitations of Lead through Methods. Textual Robot Programming – Robot Language Structure, Motion Commands, End Effectors and Sensor Commands, Program Control and Sub–routines, Monitor Mode Commands.		
Unit - IV	**Robot Control**	**9**
Introduction to Manipulator Kinematics – Homogeneous Transformations and Robot Kinematics – Manipulator Path control – Robot Dynamics – Configuration of a Robot Controller. Open and Closed loop control- The manipulator control Problem- Linear control Schemes- Partitioned PD, PID and Adaptive Control Scheme - Modeling and control of a Single Joint Robot – Linear Second order SISO Model of Manipulator Joint – Torque and Force Control of Robots. Machine Vision System		
Unit - V	**Automation and Applications of Robots**	**9**
Automation and Robotics – Selection of Robots: Material Transfer – Machine Loading – Process operations: Spot Welding – Arc Welding – Spray coating - Assembly and Inspection – Principles for Robot Applications and Applications Planning. Manufacturing Applications: Robots in Construction Trades – Underground Coal Mining – Military and Fire Fighting Operations – Undersea Robots – Space Robots. Service Applications: Teaching Robots – Medical Care and Hospital– Household Robots – Agri Bots – Micro and Nano Robots – Humanoids. Safety in robotics.		

Total:45

TEXT BOOK:

1	Mikell P.Groover, Mitchell Weiss, Roger N. Nagel & Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2012

REFERENCES:

1	Mittal R K, Nagrath I J, “Robotics and Control”, Tata McGraw Hill, New Delhi, 2010.
2	Deb S R. & Deb S., “Robotics Technology and Flexible Automation”, 2nd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the basic concept of robotics and summarize the types of drives found in robots	Understanding (K2)
CO2	recognize different types of end effectors and sensors required for specific applications	Applying (K3)
CO3	acquire knowledge in programming and control of Robots	Applying (K3)
CO4	relate the kinematics and dynamics effects for task planning in robots	Applying (K3)
CO5	develop robots for various applications with safety concern	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

20EIE31 COMPUTER CONTROL OF PROCESSES

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Process Control**	**7**	**PC**	**3**	**0**	**0**	**3**

Preamble	To provide knowledge, and understanding required to effectively analyze and design computer-controlled systems	
Unit - I	**Computer Aided Process Control**	**9**
Introduction- Role of computers in process control - Classification of computer aided process control system - batch and sequential control processes - supervisory computer control processes - Direct Digital Control processes-Computer aided process control architecture- Centralized computer control systems - Distributed computer control systems - Hierarchical computer control systems-Man Machine Interface-Economics of computer aided process control-Process related interfaces – Types of computer control process software.		
Unit - II	**Sampled Data Control Systems**	**9**
Conventional control Vs Computer control– Mathematical representation of the sampling Process– Sampling frequency considerations - Selection of optimum sampling period – Zero Order Hold-First order hold -Pulse transfer function- Complex series representation of the sampler - Development of the Pulse transfer Function - Modified z Transform-stability analysis: Asymptotic stability - BIBO stability - Internal stability- Jury's stability analysis.		
Unit - III	**Design of Controllers for linear systems**	**9**
Digital equivalent of conventional PID controller – implementation of discrete PID algorithm-controller design for process with difficult dynamics: Non-minimum phase systems – time delay systems- Smith Predictor algorithm -Inverse response systems-Inverse response compensator-Open loop unstable systems		
Unit - IV	**Pole placement design**	**9**
State space approach-concepts of controllability, observability, reachability and delectability-regulation by state feedback-observers-output feedback -the servo problem. **Polynomial approach):** simple design problem – The Diophantine equation - Design procedure -Design of controller for double integrator, Harmonic oscillator and flexible robotic arm.		
Unit - V	**Controller design for nonlinear systems**	**9**
Linearization and the classical approach-Adaptive control principles: Scheduled adaptive control -Model reference adaptive control -Self tuning adaptive control-Variable transformations. **Model based control:** Direct synthesis control -First order systems -Higher order systems -Time delay systems-Inverse response systems-Internal model control.		

Total:45

TEXT BOOK:

1	Karl AstromJ , &J ornWittenmark.B , “Computer controlled Systems: Theory and Design” , 3rd edition, Prentice Hall Publishers, 1997 for Unit 1, 2 and 4.
2.	Babatunte A. Ogunnaike & W.Harmon Ray, “Process Dynamics Modeling and Control “,1st Edition, Public Oxford University Press, Newyork, 1994 for Unit 3 and 5.

REFERENCES:

1	Singh S.K., “Computer aided Process control”, 1st Edition, Prentice Hall India Pvt Ltd, India,2004.
2	Deshpande, P.B. & Ash,R.H., “Computer Process Control”,1st Edition, ISA Publications,USA,1995.
3	Curtis D. Johnson, “Process Control Instrumentation Technology”,8th Edition, Pearson Education Limited,London,2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	recognize the impact of computers in process control	Understanding (K2)
CO2	analyze the performance of discrete time systems	Analysing (K4)
CO3	apply the concepts in the design of basic digital controllers and analyze the stability of the closed loop discrete systems	Applying (K3)
CO4	apply the concepts in designing controllers for linear and nonlinear systems.	Applying (K3)
CO5	apply the concepts of pole placement design for control applications	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1											2	2
CO2	3	3	2	2	2								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	30	30	40	-			100
CAT2	10	40	30	20			100
CAT3	10	30	30	30			100
ESE	20	20	30	30			100

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

20EIE32 DIAGNOSTIC AND THERAPEUTIC INSTRUMENTS

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Bio Medical Instrumentation	8	PE	3	0	0	3

Preamble	To impart the fundamental knowledge and applications of Digital Signal Processing	
Unit - I	**Respiratory Measurements Systems**	**9**
Pulmonary function measurements - Basic spirometer- Ultrasonic spirometer - FleischPneumotachometer - Pulmonary function analyzers - Respiratory gas analyzers-Apnea monitor. Types of ventilators – Ventilator terms - Pressure volume flow diagram – Microprocessor controlled ventilator.		
Unit - II	**Ultrasonic Imaging Systems**	**9**
Diagnostic ultrasound - Physics of ultrasonic waves - Medical ultrasound - Basic pulse-echo apparatus - Imaging modes - Real-time ultrasonic imaging systems - Duplex scanner - Modern ultrasound imaging systems -Three-dimensional ultrasound imaging systems-Portable ultrasound systems.		
Unit - III	**Arrhythmia and Ambulatory Monitoring Instruments**	**9**
Cardiac Arrhythmias - Arrhythmia monitor - QRS detection techniques - Ambulatory monitoring instruments - Data recording – Data replay and analysis. Foetal monitoring instruments: Cardiotocograph - Abdominal foetal Electrocardiogram – Foetal Phonocardiogram.		
Unit - IV	**Blood Cell Counters**	**9**
Types of blood cells – Cell counting: Microscopic method – Automatic optical method - Electrical conductivity method. Anaesthetic system: Need of anaesthesia – Anaesthesia machine. Audiometers: Mechanism of hearing -Measurement of sound – Bekesy audiometery.		
Unit - V	**Surgical and Therapeutic Instruments**	**9**
Surgical diathermy-Endoscopy basic components-Laparoscope, gastro scope, bronchoscope-Cryogenic techniques and application-Operating microscope-arthroscopy-Modern lithotripter system-laser lithotripsy.		

Total:45

TEXT BOOK:

1	Khandpur R.S., ”Handbook of Biomedical Instrumentation”, 2ndEdition, Tata McGraw-Hill, New Delhi, 2012

REFERENCES:

1	Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2003.
2	John G. Webster, “Medical Instrumentation Application and Design”, 4th Edition, John Wiley and Sons, NewYork, 2015.
3.	Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 2ndEdition, Prentice Hall of India, New Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the various measurement techniques related to respiratory system	Understanding (K2)
CO2	employ the ultrasound imaging techniques and its usefulness in diagnosis	Applying (K3)
CO3	identify the various monitoring instruments	Applying (K3)
CO4	explain the mechanisms of special assist devices	Understanding (K2)
CO5	infer the concepts in surgical and therapeutic instruments	Understanding (K2)

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

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

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

20EIE33 3D PRINTING HARDWARE

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	PE	3	0	0	3

Preamble	To address the principle behind 3D printing hardware technologies and processes for 3D based system development. To provide knowledge on various 3D printing systems and rapid tooling with applications.	
Unit - I	**Introduction and Basic Principles**	**9**
Introduction to 3D printing (Additive Manufacturing) – Additive Manufacturing (AM) parts – The Generic AM process – Terminologies in AM – The benefits of AM – Distinction between AM and CNC Machining – Example AM Parts and related technologies.		
Unit - II	**Development of Additive Manufacturing Technology**	**9**
Computers & Computer Aided Design Technology – Associated technologies – The Use of layers – Classification of AM Processes – Metal systems – Hybrid systems – Milestones in AM development.		
Unit - III	**Elements for Layer Generation**	**9**
Solidification of liquid materials – Generation from the solid phase – solidification from the gas phase and processes. Elements for generating the physical layer – Moving elements – Generating and contouring elements – Layer-generating element.		
Unit - IV	**Three-Dimensional Printing Systems**	**9**
3D printer, 3D systems, and Z corporation – Metal and molding sand printer, ExOne – Direct Shell Production Casting (DSPC) – Soligen – 3D printing system – Voxeljet – Maskless Mesoscale Material Deposition (M3D) – Optomec. Rapid Prototyping: classification and definition – Strategic and operational aspects – Applications.		
Unit - V	**Rapid Tooling & Applications for Additive Manufacture**	**9**
Rapid Tooling – Direct AM production of injection molding inserts – EDM electrodes – Investment casting and systems. **Applications:** Historical developments – The Use of AM to support medical applications – Limitations of AM for medical applications – Aerospace applications – Automotive applications.		

Total:45

TEXT BOOK:

1	Ian Gibson, David Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing", 2nd Edition, Springer New York Heidelberg, New York, 2015.

REFERENCES:

1	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publications, Cincinnati, USA, 2016.
2	Chee Kai Chua, & Kah Fai Leong, "3D Printing and Additive Manufacturing: Principles and Applications", 5th Edition, World Scientific Publishing Company, Singapore, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explore the basic principles of additive manufacturing	Understanding (K2)
CO2	exemplify the various technologies employed for 3D printing	Understanding (K2)
CO3	outline the different elements and processes for additive manufacturing	Understanding (K2)
CO4	introduce 3D systems for manufacturing materials in 3D printing	Understanding (K2)
CO5	identify rapid tooling for 3D printing and applications	Understanding (K2)

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

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	85					100
CAT2	15	85					100
CAT3	15	85					100
ESE	10	90					100

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

20EIE34 NEUROIMAGING FOR DATA ANALYSIS

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

Preamble	This course will familiarize the students with **neuroscience** methods usually generate huge volumes of **data** with often many terabytes involving various high resolution imaging modalities such as PET,dMRI,fMRI	
Unit - I	**NeuroImaging – An Introduction**	**9**
Introduction – A Brief History of Neuroimaging – Modalities – Statistical Methods: Preprocessing , Methods in Structural Neuroimaging, Localizing Areas of Activation. Positron Emission Tomography: Tracer Kinetic Modeling - Structural Magnetic Resonance Imaging: Introduction – Image Acquisition.		
Unit - II	**Diffusion Magnetic Resonance Imaging**	**9**
Introduction to Diffusion MRI - High Angular Resolution Diffusion Imaging - Diffusion Spectrum Imaging - Hybrid Diffusion Imaging - Q-Ball Imaging - Diffusion Orientation Transform – Reconstruction.		
Unit - III	**Principles of Functional Magnetic Resonance Imaging**	**9**
Introduction - The Basics of fMRI Data - BOLD fMRI - Modeling Signal and Noise in fMRI - Experimental Design – Preprocessing - Data Analysis - Resting-State fMRI		
Unit - IV	**Statistical Methods And Models**	**9**
Introduction - The Fourier Transform - FMRI Acquisition and Reconstruction - Image Processing. Statistical Analysis on Brain Surfaces: Surface Parameterization - Surface Registration - Cortical Surface Features - Statistical Inference on Surfaces: General Linear Model.		
Unit - V	**Functional Connectivity Analyses for fMRI Data**	**9**
Introduction - Methods and Measures for FC - Functional Connectivity Analysis of Resting-State fMRI Data. Effective Connectivity and Causal Inference in Neuroimaging: Introduction - Effective Connectivity - Models of Effective Connectivity - Effective Connectivity and Causation.		

Total: 45

TEXT BOOK:

1.	Hernando Ombao , Martin Lindquist , Wesley Thompson, John Aston ,"Handbook of Neuroimaging Data Analysis",1st Edition, Taylor & Francis group, 2017.

REFERENCES:

1.	F.Gregory Ashby, "Statistical Analyses of fMRI Data" 2nd edition, the MIT Press,2019.
2.	Russell A. Poldrack, Jeanette A. Mumford, & Thomas E. Nichols, "Handbook of Functional MRI Data Analysis", 1st Edition, Cambridge University Press, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the fundamentals of imaging techniques	Understanding (K2)
CO2	infer the basic concepts in diffusion magnetic resonance imaging	Understanding (K2)
CO3	summarize the principles of functional magnetic resonance imaging	Understanding (K2)
CO4	apply basics of statistical methods for analyzing brain surfaces	Applying(K3)
CO5	explain the functional connectivity analyses for fmri data	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	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	1											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	45	35				100
CAT2	25	45	30				100
CAT3	25	45	30				100
ESE	25	45	30				100

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

20EIE35 INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES

Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial Instrumentation, Process Control**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides the concepts of Petroleum processing and various Measurement and Control techniques applied to Reactors, crystallizers, Distillation columns, Pumps and water treatment plants.	
Unit - I	**Petroleum Processing**	**9**
Petroleum Exploration – Composition of petroleum – Drilling –Recovery techniques –Oil and Gas separation: Well completion methods –Feed stocks of Petrochemicals –Separation of Gases into individual constituents – Separation of liquids		
Unit - II	**Operations in Petroleum Industry**	**9**
Crude oil distillation –Refining of crude oil –Thermal conversion processes: Thermal cracking – Catalytic conversion processes: Catalytic cracking –Catalytic reforming – Hydro cracking – Catalytic alkylation – Catalytic Isomerisation – Catalytic polymerization.		
Unit - III	**Control of Reactors and Crystallizers**	**9**
Reactors: Basic operation and fundamentals – Temperature control –Once through cooling – Recirculated cooling – Cascade control –Split range controls with multiple coolants – Crystallizers: Control basis – Cooling crystallizers – Classifying crystallizers – Evaporator crystallizers – Vacuum crystallizers – Reaction crystallizers.		
Unit - IV	**Control of Distillation Columns**	**9**
Distillation equipment –Column variables –Control configurations –Product Quality Control - Direct control: Feedback control – Feed forward control – Cascade control - Inferring composition from Temperature – Column pressure control –Feed control: Feed flow rate control - Temperature control.		
Unit - V	**Safety and ATEX Terminology & Regulations**	**9**
Introduction - Intrinsic Safety - Certification of Intrinsic Safety – NEC Definition of Hazardous Locations - IEC Definition of Hazardous Locations. An Introduction to ATEX Terminology & Regulations: EC Directives - Directive 94/9/EC – ATEX 95 – Directive 1999/92/EC – ATEX 137 - North America - International IECEx Scheme - IECEx Scheme Objective – IECEx International Certification Scheme.		

Total: 45

TEXT BOOK:

1	Robert A. Meyers, “Handbook of Petroleum Refining Processes”,4th Edition, McGraw-Hill, New York,2016 for Unit 1,2,3 and 4.
2.	Liptak B.G., “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Volume 1, 4th Edition , Chilton Book Co, CRC Press, United States, 2016 for Unit 5.

REFERENCES:

1	Krishnaswamy K, “Process Control”, 2nd Edition, New Age International Publishers, New Delhi, 2006.
2	Dr. Ram Prasad, “Petroleum Refining Technology”, 1st Edition, Khanna Publishers, New Delhi, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basics of petroleum exploration and processing in petroleum industry	Understanding (K2)
CO2	illustrate the operations of petroleum refining process in petroleum industry	Understanding (K2)
CO3	build the instrumentation and control techniques involved in reactors and crystallizers	Applying (K3)
CO4	apply the various instrumentation and control schemes in distillation columns	Applying (K3)
CO5	describe the standards on Electrical, Intrinsic safety systems and ATEX Terminology & Regulations	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	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	40	50				100
CAT2	10	40	50				100
CAT3	10	30	60				100
ESE	10	40	50				100

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

20EIE36 VHDL PROGRAMMING AND ITS APPLICATIONS

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	PE	3	0	0	3

Preamble	To impart knowledge about different modeling in VHDL programming and synthesize complex digital circuits at several level of abstractions	
Unit - I	**VHDL Fundamentals**	**9**
History of Hardware Description Languages – HDL Abstraction – The Modern Digital Design Flow – VHDL Constructs – Data Types – Libraries and Packages – The Entity – The Architecture – Modeling Concurrent Functionality in VHDL – Concurrent Signal Assignments – Concurrent Signal Assignments with Logical Operators –Conditional Signal Assignments –Selected Signal Assignments –Delayed Signal Assignments –Structural Design using Components		
Unit - II	**Dataflow Modeling**	**9**
Concurrent Signal Assignment Statement – Concurrent versus Sequential Signal Assignment – Delta Delay – Conditional Signal Assignment Statement – Block Statement – Concurrent Assertion Statement – Value of a signal.		
Unit - III	**Structural Modeling**	**9**
Components: Component Declarations – Component Instantiation – Packaging Components – Configuring Component Instances: Basic Configuration Declarations – Configuring Multiple Levels of Hierarchy – Direct Instantiation of Configured Entities – Generic and Port Maps in Configurations		
Unit - IV	**Behavioral Modeling**	**9**
If Statements: Conditional Variable Assignments – Case Statements: Selected Variable Assignments – Null Statements – Loop Statements: Exit Statements – Next Statements – While Loops – For Loops – Summary of Loop Statements		
Unit - V	**Applications of VHDL in Digital System Design**	**9**
Adders – Multiplier Accumulator – FSM – ALU – Memory Design – Real Time Clock – Counters – Shift registers.		

Total:45

TEXT BOOK:

1	Peter J Ashenden, "The Designer's Guide of VHD"L, 3rd Edition, Morgan Kaufmann publisher, USA, 2008.

REFERENCES:

1	Brock J LaMeres, "Introduction to Logic Circuits & Logic Design with VHDL", 2ndEdition, Springer Publisher, Switzerland, 2019.
2	Bhasker J, "VHDL Primer", 3rd Edition, Pearson Education, New Delhi, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	acquire the knowledge about the significance of VHDL	Understanding (K2)
CO2	apply the concepts for creating dataflow modeling	Applying(K3)
CO3	design the logic circuits using structural modeling	Applying(K3)
CO4	develop the digital circuits using behavioral modeling	Applying(K3)
CO5	design and synthesize the various applications of digital circuits using VHDL programming	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			2	2
CO2	3	1								1			3	3
CO3	3	2	1	1	1					1			3	3
CO4	3	2	1	1	1					1			3	3
CO5	3	2	1	1	1					1			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	30	70					100
CAT2	10	30	60				100
CAT3	15	65	20				100
ESE	15	35	50				100

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

20EIE37 MODEL PREDICTIVE CONTROL

Programme& Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Control Systems	8	PE	3	0	0	3

Preamble	To understand the basic principles and algorithm of predictive control and to get acquainted with the fundamental contents of predictive control theory and applications	
Unit - I	**Need for predictive control**	**9**
Classical control assumptions: PID compensation-lag-lead compensation-classical control analysis. Challenges in classical methods: Controlling systems with non-minimum phase zeros and time delays – impact of delays- control of open loop unstable systems-the potential value of prediction-main components of Model Predictive Control (MPC)		
Unit - II	**Generation and development of predictive control**	**9**
Principles of Predictive Control (PC)-prediction model-dynamic matrix control (DMC) based on step response model-DMC algorithm and implementation-DMC in state space framework-general predictive control based on the linear difference equation model – PC based on state space model.		
Unit - III	**Synthesis of stable predictive control**	**9**
Fundamental philosophy of qualitative synthesis theory of PC -relationship between MPC and optimal control-synthesis of stable PC – PC with zero terminal constraints – PC with terminal cost functions-general stability conditions of PC- sub-optimality analysis of PC.		
Unit - IV	**Predictive control of non-linear systems**	**9**
General description of PC for non-linear systems- PC based on input-output linearization – multiple MPC based on fuzzy clustering – neural network PC – PC for Hammersian systems – PC with feed-forward and feedback structure – cascade PC.		
Unit - V	**Applications of predictive Control**	**9**
Industrial applications and software development of PC -role of PC in industrial process optimization – key technologies pf PC implementation – process description and control system configuration -problem formulation and variable selection – plant testing and model identification-application of PC in an automatic train operation system and in solar power plant.		

Total:45

TEXT BOOK:

1	Rossiter J.A., "A First Course in Predictive Control" 2nd Edition, CRC Press, USA,2018 for Unit 1.
2	Yugeng Xi,& Dewei Li, "Predictive Control: Fundamentals and Developments", 1st Edition, Wiley Publishers, USA, 2019 for unit 2,3,4 and 5.

REFERENCES:

1	Camacho E.F., & Bordons C., "Model Predictive control in Process Industry"",1st Edition, Springer publications,London,1995.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Recognize the need for predictive control and to identify the main components	Understand (K2)
CO2	Formulate the predictive control problem and algorithms	Applying (K3)
CO3	Apply the concepts of synthesizing stable predictive control	Applying (K3)
CO4	Apply the concepts of predictive control in non-linear systems	Applying (K3)
CO5	Realize the applications of model predictive control in industries	Understand (K2)

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

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

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

20GEO04 - INNOVATION AND BUSINESS MODEL DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme& Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	OE	3	1	0	4

Preamble	This course will inspire the students to think innovation concepts and ideas for business model developments.	
Unit - I	**Innovation and Design Thinking:**	**9+3**
Innovation and Creativity– Types of innovation – challenges in innovation- steps in innovation management- 7 concerns of design. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping		
Unit - II	**User Study and Contextual Enquiry:**	**9+3**
Explanatory research – primary and secondary data – classification of secondary data – sources of secondary data – qualitative research – focus groups – depth interviews – analysis of qualitative data – survey methods – observations- Process of identifying customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications		
Unit - III	**Product Design:**	**9+3**
Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction		
Unit - IV	**Business Model Canvas (BMC):**	**9+3**
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies		
Unit - V	**IPR and Commercialization:**	**9+3**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	RishikeshaT.Krishnan, “8 Steps To Innovation: Going From Jugaad To Excellence”, Collins India, 2013.

REFERENCES:

1.	Peter Drucker, “Innovation and Entrepreneurship”, Routledge CRC Press, London, 2014.
2.	Eppinger, S.D. and Ulrich, K.T. “Product design and development”, 7th edition, McGraw-Hill Higher Education, 2020.
3.	Alexander Osterwalder, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st edition, John Wiley and Sons; 2010
4.	Indian Innovators Association, “Patent IPR Licensing – Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators”, Notion Press, Chennai, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand innovation need and design thinking phases	Understanding (K2)
CO2	identify, screen and analyse ideas for new products based on customer needs	Analysing (K4)
CO3	develop and analyse the product concepts based on the customer needs and presents the overall architecture of the product.	Analysing (K4)
CO4	predict a structured business model for MVP	Applying (K3)
CO5	practice the procedures for protection of their ideas' IPR	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20GEO19 ENTREPRENEURSHIP DEVELOPMENT

(Common to all Engineering and Technology Branches)

Programme& Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Engineering Economics and Management	6	EC	3	0	0	3

Preamble	The purpose of this course to create entrepreneurial awareness among engineering students.	
Unit - I	**Entrepreneurship Concepts:**	**9**
Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation - Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship & Entrepreneurs - Characteristics of Entrepreneurs -Entrepreneurship Development in India		
Unit - II	**Entrepreneurial Ventures and opportunity assessment:**	**9**
New venture creation – Bootstrapping,Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture development stages - Models of market opportunity- Opportunity assessment: Critical Factors In Opportunity Assessment, Idea vs Opportunity, Evaluation process, Global opportunities for entrepreneurs.		
Unit - III	**Business Plan:**	**9**
Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process – Structure of a Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan formulation - Presentation of the Business Plan: The 'Pitch'- case studies		
Unit - IV	**Financing and accounting:**	**9**
Forms of entrepreneurial capital – Sources of Financial capital: debt financing- Commercial banks and other sources, equity financing: Initial Public offering (IPO), Private placement - Venture capitalists - Angel investors-New forms of financing: Impact investors, Micro-financing, Peer-to-Peer Lending, Crowd funding - Natural capital. Preparing Financial Budget, Break even analysis, Taxation-Direct and indirect taxes, Insolvency and Bankruptcy.		
Unit - V	**Small Business Management:**	**9**
Definition of Small Scale Industries: Strengths and Weaknesses, Sickness in Small Enterprises: Symptoms -Causes and remedies-Indian Startup Ecosystem – Institutions supporting small business enterprises, Business Incubators – Government Policy for Small Scale Enterprises - Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger, FDI and Sub-Contracting		

Total:45

TEXT BOOK:

1.	Donald F. Kuratko,"Entrepreneurship: Theory, Process, Practice", 11th Edition, Cengage Learning, Boston, 2020.

REFERENCES:

1.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha "Entrepreneurship", 11th Edition, McGraw Hill, Noida, 2020.
2.	Charantimath Poornima .M, "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
3.	Gordon E & Natarajan K, "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur	Applying (K3)
CO2	identify suitable entrepreneurial ventures and business opportunity	Applying (K3)
CO3	assess the components of business plan	Analyzing (K4)
CO4	appraise the sources of finance and interpret accounting statements	Applying (K3)
CO5	interpret the causes of sickness of small scale enterprises and its remedies	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	1	1		3	2		1
CO2	1	2	2	2		2	2	1	1		3	2		2
CO3	2	2	2	2	2	2	2	2	2	2	3	2		1
CO4	1	1	2	1		2	1	1	1	2	3	2		1
CO5	1	1	2	1		2	1	1	1	2	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	30	30	20			100
CAT3	30	30	40				100
ESE	20	30	40	10			100

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

20EIO01 - DIGITAL IMAGE PROCESSING AND ITS APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**4**	**OE**	**3**	**1**	**0**	**4**

Preamble	To impart the fundamental knowledge and applications of Digital Image Processing	
Unit - I	**Introduction to Image Processing:**	**9+3**
Overview to Image Processing – Nature of Image Processing – Image Processing and Related Fields – Digital Image Representation – Types of Images – Fundamental Steps in Image Processing. Digital Image Processing Operations: Basic Relationships and Distance Metrics – Classification of Image Processing Operations – Arithmetic Operations: Image Addition, Image Subtraction, Image Multiplication, Image Division – Logical Operations: AND/NAND, OR/NOR, XOR/XNOR, NOT – Geometrical Operations: Translation, Scaling, Rotation – Image Interpolation Techniques – 2D Convolution and Correlation.		
Unit - II	**Image Transform:**	**9+3**
Need for Image Transforms – 2D Discrete Fourier transform – 2D Discrete Cosine Transform – Haar Transform – SVD and KL Transforms.		
Unit - III	**Image Enhancement:**	**9+3**
Image Quality and Need for Image Enhancement – Image Enhancement Point Operations – Linear and Non-linear Functions – Piecewise Linear Functions: Intensity Slicing, Bit-plane Slicing – Histogram Equalization – Spatial Filtering Concepts: Design of Discrete Gaussian Mask, Order-statistics Filters (Median, Maximum, Minimum) – Image Smoothing in Frequency Domain – Image Sharpening in Frequency Domain. Case study: Improve the visual quality of images.		
Unit - IV	**Image Segmentation:**	**9+3**
Introduction – Classification of Image Segmentation Algorithms – Detection of Discontinuities – Edge Detection: Stages in Edge Detection, Types of Edge Detectors – First-order Edge Detectors: Roberts Operator, Prewitt Operator, Sobel Operator – Second-order Derivatives Filters: Laplacian of Gaussian (Marr-Hildrith) Operator, Canny Edge Detection – Principle of Thresholding: Histogram and Thresholding, Global Thresholding Algorithms – Principle of Region-growing.		
Unit - V	**Image Processing Applications:**	**9+3**
Image Registration – Image Fusion – Digital Watermarking – Face Recognition: Pixel-based Techniques.		

Lectur:45, Tutorial:15, Total :60

TEXT BOOK:

1.	Sridhar S., "Digital Image Processing", 2nd Edition, Oxford University Press (Oxford HED), India, 2016.

REFERENCES:

1.	Jayaraman S., Veerakumar T., & Esakkirajan S., "Digital Image Processing", 1st Edition, Tata McGraw-Hill, New Delhi, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic image processing operations	Understanding (K2)
CO2	apply various 2D transforms for images	Applying (K3)
CO3	interpret image enhancement techniques and morphological operations	Applying (K3)
CO4	examine various image segmentation algorithms	Applying (K3)
CO5	construct case study on image processing applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	44	36				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20EIO02 - INDUSTRIAL AUTOMATION
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	OE	3	1	0	4

Preamble	To provide solution towards better control action for various process applications	
Unit - I	**Introduction To Industrial Automation:**	**9+3**
Automation - Industrial Automation vs. Industrial Information Technology - Role of automation in industry - Types of production systems - Types of Automation Systems - The Functional Elements of Industrial Automation - Industrial Sensors and Instrument Systems - Industrial Actuator Systems - Industrial Control Systems - The Architecture of Elements: The Automation Pyramid.		
Unit - II	**Programmable Logic Controllers (PLCs) An Overview:**	**9+3**
Parts of a PLC -Principle of operation. PLC Hardware Components: Discrete I/O Modules- Analog I/O modules – The Central Processing Unit (CPU) – Programming Terminal Devices. Converting Relay Schematics into PLC Ladder Programs. Programming Timers: Timer Instructions - Types of timers - On-Delay Timer Instruction - Off-Delay Timer Instruction - Retentive Timer.		
Unit - III	**Advanced PLC Programming:**	**9+3**
Programming Counters: Counter Instructions – Up-Counter – Down - Cascading Counters - Program Control Instructions: Master Control Reset Instruction - Subroutine Functions. Data Manipulation Instructions: Data Compare Instructions. Math Instructions: Addition Instruction - Subtraction Instruction - Multiplication Instruction – Division Instruction.		
Unit - IV	**Process Control, Network Systems, and SCADA:**	**9+3**
Types of Processes - Structure of Control Systems - On/Off Control - PID Control - Motion Control - Data Communications - Supervisory Control and Data Acquisition (SCADA) - Human Machine Interfaces (HMIs) – Introduction to DCS.		
Unit - V	**Internet of Things - An Overview:**	**9+3**
Introduction - Internet of Things Definition Evaluation – IOT Architectures – IOT Data Management and Analytics – Communication Protocols - Internet of Things Applications – Security – Identity Management and Authentication – Privacy – Standardization and Regulatory Limitations.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, Tata McGraw Hill Education Private Limited, India, 2019.

REFERENCES:

1.	Rajkumar Buyya & Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", 1st Edition, Morgan Kaufmann (Imprint of Elsevier), USA, 2016.
2.	https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf
3.	https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-02(SM)(IA&C)%20((EE)NPTEL).pdf

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the concepts about basics of automation system	Understanding (K2)
CO2	develop programming with PLC	Applying (K3)
CO3	analyze theory of operation in advanced PLC and SCADA	Applying (K3)
CO4	interpret the architectural interfaces and operation about DCS	Understanding (K2)
CO5	illustrate the advanced technologies, opportunities, challenges to bring out industry 4.0	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	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											2	2

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

ASSESSMENT PATTERN - THEORY

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

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

20EIO03 - MEASUREMENTS AND INSTRUMENTATION
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	OE	3	1	0	4

Preamble	This course impart the knowledge of measuring instruments for measuring electrical and electronic parameters. Measurements and Instrumentation course gives overview of various measurements like PMMC,MI, power, Energy,recorders and various methods of measurements using AC bridges and transducers.	
Unit - I	**Electrical Meters:**	**9+3**
Deflecting, controlling and damping forces in indicating instruments – Principle and operation: D'Arsonval Galvanometers-Torque Equation- Permanent Magnet Moving Coil instruments -Moving iron instruments -Dynamometer type Wattmeter- Single Phase induction type Energy meters.		
Unit - II	**DC Null Methods:**	**9+3**
Measurement of Resistances: Classification of Resistances –Measurement of Medium Resistances: Wheatstone Bridge-Measurement of low resistance:Kelvin Double Bridge– Measurement of high resistance :Megger – Earth resistance measurement. **Potentiometers:** Basic Potentiometer circuit-Laboratory Type(Crompton's) potentiometer-Applications: calibration of ammeter, voltmeter, wattmeter using potentiometer, measurement of unknown resistance using DC potentiometer. .		
Unit - III	**Methods of Measurements using AC bridges :**	**9+3**
Introduction to A.C. bridges-Sources and detectors-General Equation for bridge balance-General form of an AC bridge-Measurement of Self Inductance: Maxwell's inductance Bridge and Anderson's bridge. Measurement of Capacitance: Schering bridge. Measurement of Mutual Inductance: uses of Mutual Inductance in bridge circuits,Heaviside mutual inductance bridge. Measurement of frequency:Wien's bridge.		
Unit - IV	**Display Devices and Recorders:**	**9+3**
Segmental Displays:Seven segment display-Dot Matrices-Rear Projection Display-Mixie Tube- Light Emitting Diode-Liquid Crystal Diode-X-Y Recorders-Magnetic Tape Recorders-Digital tape recorders.		
Unit - V	**Transducers:**	**9+3**
Classification of Transducers-Primary and Secondary –Passive and Active- Analog and Digital-Inverse Transducers. Resistive Transducers: Strain Gauges-Theory of Strain Gauge- Thermistor: Construction of Thermistor. Thermocouple: Construction of Thermocouple. Linear Variable Differential Transformers (LVDT): Construction – Advantages and Disadvantages.		

Lectur:45, Tutorial:15, Total :60

TEXT BOOK:

1.	Sawhney A.K., "A Course in Electronic Measurements and Instrumentation", 2nd Edition, Dhanpat Rai & Co. Pvt. Ltd., New Delhi, 2015.

REFERENCES:

1.	Joseph J.Carr, "Elements of Electronic Instrumentation and Measurement", 3rd Edition, Pearson Education Pvt Ltd, New Delhi,2008.
2.	Oliver B.M., & Cage, J.M., "Electronic Measurements and Instrumentation",3rd Edition, McGraw-Hill, New York, 1975.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the working of various electrical meters	Understanding (K2)
CO2	employ the DC null methods for measurement of resistance	Applying (K3)
CO3	make use of the AC bridges for measurement of Capacitance	Applying (K3)
CO4	interpret the concepts of storage and display devices in instruments	Understanding (K2)
CO5	select appropriate Transducer for different applications	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20EIO04 - BIOMEDICAL INSTRUMENTATION AND APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	0	0	3

Preamble	To impart the knowledge of some human anatomy and measuring bio potentials using bio electrodes with specific instruments which is most commonly used in hospitals. Also understand the fundamental concept of various biomedical imaging techniques and learn the advanced physiological assistive medical devices.	
Unit - I	**Human Physiological Systems:**	**9**
Cell and its structure - Resting and action potentials - Different systems of human body: Circulatory system - Respiratory system - nervous system - Components of the Bio medical instrument system - strain gauge as pressure transducer – photoelectric type resistive transducer – piezoelectric ultrasonic transducer.		
Unit - II	**Bio Potential Electrodes:**	**9**
Micro electrode-depth and needle electrode-surface electrodes. Biomedical Electrical signal measurement: ECG, EEG, EMG, EOG and ERG): Lead systems, recording methods and typical waveforms.		
Unit - III	**Biomedical Non Electrical Signal Measurement:**	**9**
Phonocardiography - GSR- Blood pressure Measurement: Sphygmomanometer, MEMS based catheter tip pressure sensor, ultrasonic blood pressure monitor. Spirometer - Blood pH measurement - Ear oximeter - Pulse oximeter - Lung volumes, respiration and cardiac rate.		
Unit - IV	**Biomedical Imaging Systems:**	**9**
X-ray machine - Computer tomography – Thermography - Ultrasonic imaging systems - Magnetic resonance imaging – PET - SPECT - FMRI - Magnetic Particle Imaging.		
Unit - V	**Physiological Assist Devices:**	**9**
Ventricular asynchronous pacemaker - AC Debrillator - Heart lung machine - Kidney machine – Audiometer - Biothesiometry Vibroscreen - Biotelemetry - Telemedicine.		

Total:45

TEXT BOOK:

1.	Khandpur R.S., "Handbook of Biomedical Instrumentation", 2nd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2012.

REFERENCES:

1.	John G. Webster, "Medical Instrumentation Application and Design", 4th Edition, John Wiley and Sons, Newyork, 2015.
2.	Andrew G. Webb, "Principles of Biomedical Instrumentation", 1st Edition, Cambridge University Press, United Kingdom, 2018.
3.	Arumugam M., "Bio-Medical Instrumentation", 2nd Edition, Anuradha Publications, India, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the basic principles and phenomena of biomedical engineering	Understanding (K2)
CO2	record the bioelectric potentials using bio potential electrode through bio signal recording devices	Applying (K3)
CO3	measure biomedical signal parameters through medical instruments	Applying (K3)
CO4	summaries the basic principles in medical imaging techniques	Understanding (K2)
CO5	interpret the physiological assist devices	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							2	2
CO2	3	2	1	1	1	1							3	3
CO3	3	2	1	1	1	1							3	3
CO4	3	1				1							2	2
CO5	3	2	1	1	1	1							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	28	28	44				100
CAT2	12	24	64				100
CAT3	24	32	44				100
ESE	24	32	44				100

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

20EIO05 - PLC PROGRAMMING AND ITS APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	0	0	3

Preamble	To develop and implement the Programmable controller based Industrial Automation	
Unit - I	**Programmable Logic Controllers (PLCs) An Overview:**	**9**
Parts of a PLC -Principle of operation - PLCs versus Computers, PLC Size and Applications. PLC Hardware Components: The I/O Section - Discrete I/O Modules- Analog I/O modules - Special I/O modules - I/O Specifications – The Central Processing Unit (CPU) – Programming Terminal Devices – Recording and Retrieving - Human Machine Interfaces (HMIs).		
Unit - II	**Basics of PLC Programming:**	**9**
The Binary concept - AND,OR and NOT functions - Boolean algebra - Hardwired Logic versus Programmed Logic - Processor Memory organization - Program Scan - PLC Programming Languages - Instruction Addressing - Branch instructions - Internal Relay Instructions – Entering Ladder Diagram - Modes of Operation.		
Unit - III	**PLC Wiring Diagrams and Programs:**	**9**
Electromagnetic Control Relays – Contactors - Motor Starters - Manual Operated Switches - Mechanically Operated Switches – Sensors - Output Control Devices – Seal-In Circuits - Latching relays - Converting Relay Schematics into PLC Ladder Programs. Programming Timers: Timer Instructions - Types of timers - On-Delay Timer Instruction - Off-Delay Timer Instruction - Retentive Timer.		
Unit - IV	**Advanced PLC Programming:**	**9**
Programming Counters: Counter Instructions – Up-Counter – Down - Cascading Counters – Combining Counter and Timer Functions. Program Control Instructions: Master Control Reset Instruction - Jump Instruction - Subroutine Functions. Data Manipulation Instructions: Data Compare Instructions. Math Instructions: Addition Instruction - Subtraction Instruction - Multiplication Instruction – Division Instruction.		
Unit - V	**Applications:**	**9**
Detecting the standing bottles on the conveyor - Sequential control - Batch Process Control – Direct On Line Start / Stop - First in Priority control - 24-hour clock - Automatic Door opening and closing - Entry/Exit Control of the Underground Car Parking.		

Total:45

TEXT BOOK:

1. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.

REFERENCES:

1. John W. Webb & Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", 5th Edition, Pearson Education India, India, 2015.
2. http://plc-scada-dcs.blogspot.com

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	gain knowledge on the basic components of programmable automation	Understanding (K2)
CO2	interpret various programming logics and languages of PLC	Applying (K3)
CO3	develop hardware wiring and programming with PLCs	Applying (K3)
CO4	implement the concepts of timer and counter based sequence control	Applying (K3)
CO5	apply programmable controller based in industrial applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	30	60				100
CAT2	10	30	60				100
CAT3		40	60				100
ESE	10	30	60				100

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

20EIO06 – INSTRUMENTATION FOR INDUSTRY 4.0
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

Preamble	To transform the industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.	
Unit - I	**Introduction To Instrumentation and Industry 4.0:**	**9**
Introduction to Sensors – Measurement Objectives – Pressure – Temperature – Level – Flow - Wireless Measurements – Wireless control objective – Introduction to IIOT - Key opportunities and benefits of IIOT: Digital and human workforce – Industrial Internet use-cases - Industry 4.0: Characteristics and design principles.		
Unit - II	**Industrial Automation:**	**9**
Need of Automation – Components of Automation Systems – Computer based Controllers – Architecture and component : Programmable Logic Controller, SCADA and Distributed Control Systems		
Unit - III	**Communication Protocols:**	**9**
Modern Communication protocols: Industrial Ethernet, Encapsulated Field Bus, Standard Ethernet. IIoT device Low-Power WAN optimized technologies for M2M: SigFox, LoRaWAN, nWave, Dash7, Ingenue RPMA, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio		
Unit - IV	**Cyber Security in the Industry 4.0 Era:**	**9**
Introduction -Security threats and vulnerabilities of IoT-Industrial challenges - evolution of cyber attacks – cases (cyber attack and solutions) on Industrial control systems- strategic principles of Cyber security - Cyber security measures		
Unit - V	**Technologies and Applications:**	**9**
Data Analytics and Software Defined Networks - Application domains: Healthcare, power plants, oil, chemical and pharmaceutical industry, Advances in robotics in industries: Recent technological components of robots and Industrial Robotic applications in manufacturing, maintenance and assembly		

Total: 45

TEXT BOOK:

1.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", 1st Edition, Apress media, California, 2016

REFERENCES:

1.	Alp Ustundag and EmreCevikcan, "Industry 4.0: Managing the Digital Transformation", Springer series in Advanced Manufacturing, Switzerland, 2018
2.	Popovic D and Bhatkar V.P., "Distributed Computer Control for Industrial Automation", Marcel Dekkar Inc., New York, 1990.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the basics of Instrumentation and Industry 4.0	Understanding (K2)
CO2	interpret the concepts of Industrial automation	Understanding (K2)
CO3	interpret protocols and sensors for Industry 4.0	Understanding (K2)
CO4	impart the knowledge of Cyber security in Industry 4.0	Understanding (K2)
CO5	apply technologies of Industry 4.0 in real time Industrial 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
CO3	3	2	1	1	1								2	2
CO4	3	1											2	2
CO5	3	2	1	1	1								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	15	85					100
CAT2	10	50	40				100
CAT3	5	35	60				100
ESE	10	50	40				100

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

20EIO09 INSTRUMENTATION TECHNIQUES IN AGRICULTURE
(Offered by Department of EIE)

Programme& Branch	All BE/BTech branches except EIE	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

Preamble	To discuss the sensing and automation technology associated with agriculture.	
Unit - I	**Necessity of Instrumentation**	**9**
Necessity of instrumentation & control for agriculture and food processing requirement, World Agriculture Scenario, Indian Agriculture sector – A synoptic Review- Areas of Concern. Information, Interpretation and Instruction Systems – Agri Instrumentation. Introduction to Transducers – Characteristics.		
Unit - II	**Agri Transducers**	**9**
Technology Trend – Conventional and Silicon transducers, Capacitive gauges, Silicon Displacement transducer, Silicon Temperature transducer, Silicon Pressure Transducer. Grain Moisture transducers, soil moisture transducers, Humidity transducers, pH transducers, Gas transducers, Intelligent Sensors.		
Unit - III	**Processor Based Application**	**9**
Microprocessor based Grain moisture measurement- Introduction, Sensing Mechanism, I/O requirement analysis. Microprocessor based Soil Nutrient Estimation Systems- Soil nutrients and their role, collection of samples, soil nutrient estimation, sensing mechanism. Preparation of soil extract for estimation of N,P,K and S, I/O requirement Analysis. Supervisory control and Data Acquisition System (SCADA) – Introduction, SCADA system basic Signals, SCADA Functions.		
Unit - IV	**Drip Irrigation and Precision Agriculture**	**9**
: Introduction-Sensors, Hardware block Schematic, system operation, I/O Requirement Analysis, Hardware Systems. Precision: Introduction, need for precision agriculture. Subsystem and components- GPS, Agri sensors, DAS, Communication System. Precision agriculture status – Working Philosophy.		
Unit - V	**Green House Cultivation**	**9**
Designs and classification of greenhouse- Orientation of Greenhouse / Poly house- Components of green house- Plant growing structures/containers in green house production- Environmental factors influencing greenhouse cultivation- Media preparation and fumigation- Drip irrigation and fertigation systems greenhouse cultivation- Problem management in greenhouse cultivation		

Total:45

TEXT BOOK:

1	Krishna Kant , “Microprocessor Based Agri Instrumentation”, 1st Edition, PHI Private Limited, New Delhi, 2010.

REFERENCES:

1	Greenhouse Cultivation, Tamilnadu Agritech Portal. http://agritech.tnau.ac.in/horticulture/horti_Greenhouse%20cultivation.html
2	Sidney Walter Reginald Cox, Filby D E , “Instrumentation in Agriculture”, Lockwood Publishers, UK, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the necessity of instrumentation for agriculture	Understanding (K2)
CO2	familiarize with the Soil parameters and tranducers in agricultural instrumentation	Understanding (K2)
CO3	Illustrate the techniques of agriculture using Microprocessor and SCADA	Understanding (K2)
CO4	Outline the fundamentals of Drip Irrigation and Precision Agriculture	Understanding (K2)
CO5	Utilize the concepts of greenhouse cultivation in Agriculture	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	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	1											2	2
CO5	3	1											2	2

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	30	70					100

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

20EIO07 - GRAPHICAL PROGRAMMING USING VIRTUAL INSTRUMENTATION

(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	0	0	3

Preamble	Virtual instrumentation is a powerful concept for control, measuring, testing and analysis of real time problems using graphical programming techniques with DAQ system. The classical methods suffers from certain limitations. This course aims at giving an adequate exposure and practice in LabVIEW programming and DAQ system.	
Unit - I	**Graphical System Design:**	**9**
Graphical system Design (GSD) Model-Design Flow with GSD – Virtual Instrumentation Architecture – Virtual Instruments and Traditional Instruments – Advantages of Virtual Instruments - Hardware and Software in Virtual Instrumentation- Evolution of LabVIEW- Creating Virtual Instruments Using LabVIEW-Graphical Programming and Textual Programming - Advantages of LabVIEW- LabVIEW Environment- Dataflow Programming- ‘G’ Programming.		
Unit - II	**Basic Tools, Loops and Graphs:**	**9**
Front Panel Block Diagram Tools and Palettes- Repetition and Loops: FOR Loop, While Loop, Shift Registers, Tunnels, Feedback Nodes, Local and Global Variables – Arrays-Clusters-Waveform Charts-Waveform Graphs-XY Graphs-Intensity Graphs and Charts-Digital Waveform Graph-3D Graphs.		
Unit - III	**Programming with Structures:**	**9**
Structures: Case Structure, Sequence Structures, Customizing Structures, Timed Structures, Formula Nodes, Event Structure, MathScript-Strings-File I/O-State Machine.		
Unit - IV	**Data Acquisition:**	**9**
Signals-Signal Grounding-Signal Conditioning-Digital I/O Techniques-Data Acquisition in LabVIEW-Hardware Installation and Configuration-Components of DAQ-DAQ Signal Accessory-DAQ Assistant-DAQ Hardware- DAQ Software.		
Unit - V	**Tools and Applications:**	**9**
Signal processing and Analysis Tools-Control System Design and Simulation Tools-Signal, Voltage and Current measurement using general purpose DAQ Card-Bio-Medical Signal Acquisition using NI-ELVIS -Temperature Measurement.		

Total: 45

TEXT BOOK:

1. Jovitha Jerome, "Virtual Instrumentation Using LabVIEW", 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

REFERENCES:

1. Sumathi S and Surekha P, "LabVIEW Based Advanced Instrumentation Systems", 1st Edition, Springer Publications, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the Virtual Instrumentation concepts	Understanding (K2)
CO2	apply structured programming concepts in developing LabVIEW programs	Applying (K3)
CO3	engage in designing, implementing and analyzing an application using different tools	Analyzing (K4)
CO4	build applications that uses DAQ System	Applying (K3)
CO5	apply knowledge on various tools in practical works	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	3	2	2	2								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								3	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	10	20	50	20			100
CAT3	10	30	40	20			100
ESE	10	30	50	10			100

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

20EIO08 - TESTING OF MATERIALS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/B-Tech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	To understand the various destructive and non destructive testing methods of materials and its industrial applications.	
Unit - I	**Introduction to material testing:**	**9**
Need for testing - Overview of materials – Classification of material testing - Purpose of testing –Selection of material - Development of testing -Testing organizations - Testing standards - Result analysis - Advantages of testing.		
Unit - II	**Mechanical Testing:**	**9**
Introduction to mechanical testing: Hardness and its measurement (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) – Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test – Principles, Techniques, Methods, Advantages and Limitations, Applications.		
Unit - III	**Non Destructive Testing:**	**9**
Visual inspection - Basic Principle, Optical aids used for visual inspection - Microscope, Bore scope, Endoscope, Holography, Telescope, Flexi scope- Applications. Penetrant testing methods: Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test- Principles, Techniques, Methods, Advantages and Limitations, Applications.		
Unit - IV	**Material Characterization Testing:**	**9**
Macroscopic and Microscopic observations - Optical and Electronic microscopy (SEM and TEM) Principles, Types, Advantages and Limitations. Applications - Diffraction techniques - Spectroscopic techniques - Scanning Probe microscopy- Principles, types, advantages and limitations.		
Unit - V	**Miscellaneous Testing:**	**9**
Thermal Testing: Differential Scanning Calorimetry- Electron Probe Micro Analyzer (EPMA) – Atomic Force Microscopy and FTIR Spectroscopy: Principles, Advantages, and Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma - Optical Emission Spectroscopy and Plasma - Mass Spectrometry.		

Total: 45

TEXT BOOK:

1.	Baldev Raj, Jayakumar T., & Thavasimuthu M., “Practical Non-Destructive Testing”, 1st Edition, Narosa Publishing House, Woodhead Publishing Limited, 2009.

REFERENCES:

1.	Higgins R.A. & Bolton, “Materials for Engineers and Technicians”, 5th edition, Butterworth Heinemann, Imprint of Elsevier. 2010.
2.	Yang Leng, “Materials Characterization: Introduction to Microscopic and Spectroscopic Methods”, 2nd Edition, Wiley-online library, Verlag, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	retrieve the concepts of material testing	Understanding (K2)
CO2	employ mechanical testing concepts based on the properties of materials	Understanding (K2)
CO3	interpret on the rudiments of non destructive testing techniques.	Applying (K3)
CO4	investigate the characteristics of materials based on several scanning methods	Applying (K3)
CO5	recommend the suitable testing method of materials for engineering applications	Understanding (K2)

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

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

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

20EIO10 - INDUSTRIAL DATA COMMUNICATION
(Offered by Department of EIE)

Programme& Branch	All BE/BTech branches except EIE	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	This theory course aims in imparting fundamental knowledge of analog and digital modulation techniques. It will provide the types of protocols used for the purpose of serial communication and industrial communication.	
Unit - I	**Modulation**	**9**
Need of modulation – Amplitude modulation and demodulation – Frequency modulation and demodulation – Shannon's sampling theorem – Pulse code modulation. Multiplexing: Frequency and Time division multiplexing. Digital modulation: Amplitude shift keying – Phase shift keying – Frequency shift keying		
Unit - II	**Serial Communication**	**9**
OSI reference model– Protocols, – RS-232 overview, RS-232 interface standard (CCITT V.24 interface standard)– Half-duplex operation of the RS-232 interface– Summary of EIA/TIA– 232 revisions, Limitations– RS-485 overview– The RS-485 interface standard– RS-485 Troubleshooting, RS-485 vs RS-422- RS-485 Installation– Noise problems– Test equipment– The 20 mA Current loop.		
Unit - III	**Communication Cable:Copper cable**	**9**
Characteristics– Cable selection – Coaxial cables– Twisted-pair cable – Distribution /installation standards– Connector standards. **Fibre optics Communication**: Fibre-optic cable components– Cable parameter– Types of optical fibre– Basic cable types– Connecting fibers		
Unit - IV	**Communication Protocols: Modbus**	**9**
Modbus Overview – Modbus protocol structure – Function codes -query response cycle, transmission mode– Message Formatting. **Profibus PA/DP/FMS :**Profibus protocol stack– The Profibus communication model– Relationship between application process and communication – Communication objects. **TCP/IP**- Internet layer protocols (packet transport) - Internet layer- The host-to-host layer - End to end reliability- 10 Mbps Ethernet -100 Mbps Ethernet -Gigabit Ethernet		
Unit - V	**Industrial communication: HART**	**9**
HART Introduction – HART and smart instrumentation – Physical layer, Data link and application layer **-** HART Commands – HART protocol problems **Foundation Field Bus**: Introduction - The Physical layer and Wiring Rules– The Data link layer– The Application layer– The User layer– Error detection and diagnostics - High-speed Ethernet (HSE)		

Total:45

TEXT BOOK:

1	Steve Mackay, Edwin Wright, & Deon Reynders, " Practical Industrial Data Networks: Design, Installation and Troubleshooting" 1st Edition ,Elsevier,USA, 2004.

REFERENCES:

1	Wayne Tomasi, "Electronic Communication Systems: Fundamentals through Advanced", 5th Edition, Pearson Education, New Delhi, 2013.
2	William L. Schweber, "Data Communications", 1st Edition, Tata McGraw-Hill,New Delhi, 2009.
3	Ian Verhappen & Augusto Pereira, "Foundation Fieldbus", 4th Edition, International Society of Automation,2012.
4	Forouzan, BehrouzA., "Data communication and Networking", 4th Edition, Tata McGraw-Hill, New Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Summarize the concepts of types of modulation and demodulation and digital modulation	Understanding (K2)
CO2	Make use of the essentials of the communication system and learn the serial communication interface	Understanding (K2)
CO3	Interpret knowledge about Copper cable and fiber optic cable communication	Understanding (K2)
CO4	Examine the suitability of various communication protocols	Applying (K3)
CO5	Identify the applications of HART and Field bus	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1				1		1					2	2
CO2	3	1				1		1					2	2
CO3	3	1				1		1					2	2
CO4	3	2	1	1	1	1		1					3	3
CO5	3	2	1	1	1	1		1					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	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

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

20EIO11 - WIRELESS INSTRUMENTATION
(Offered by Department of EIE)

Programme& Branch	**All BE/BTech branches except EIE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge on wireless technology for instrumentation, wireless components and its applications. To provide adequate technical information on power sources, wireless protocols and network implementation.	
Unit - I	**Wireless Instrumentation Technology**	**9**
Introduction – Instruments and Instrumentation: Measurement systems – Multiplexing structures – Wireless instruments and communication protocols – RF interfaces and examples – Networks of wireless instruments – Sensor node components: Computing subsystem – Communication subsystem – Power subsystems – Sensing subsystems		
Unit - II	**Powering Autonomous sensors**	**9**
Autonomous sensors – Ambient energy sources and transducers – Energy storage units – Power considerations of wireless instruments – Energy harvesting: Solar and wind energy harvesting, RF energy harvesting, Energy harvesting from vibration, Thermal energy harvesting – Energy management techniques – Calculation for battery selection – Understanding RSSI and LQI values.		
Unit - III	**Wireless Systems/Standards for Automation**	**9**
Wireless HART: Protocol stack – Network components – Addressing control – Coexistence techniques. ISA100.11a: Introduction – Scope – Working group of ISA 100 – Features – Sensor classes – System configuration and architecture of ISA 100.11a – Comparison between ISA100.11a and WHART protocol stacks.		
Unit - IV	**Design of Wireless Devices**	**9**
Wireless sensor and instrument network design – Wireless integrated network sensors – Plug-and-play sensors and networks – Industrial wireless networks and automation. **LoRa:** Introduction – Communication Methods – Difference between LoRa and LoRaWAN – LoRaWAN architecture – LoRaWAN classes.		
Unit - V	**Wireless Sensor and Instrument Applications**	**9**
Application specific wireless sensors and instruments – Commercial wireless sensors and instruments – Industrial wireless sensor and instrument networks – Wireless human health monitoring and environmental applications – Radio frequency identification – Consumer products and other applications – Applications in Transportation and Agriculture.		

Total:45

TEXT BOOK:

1	John G. Webster, HalitEren, “Measurement, Instrumentation, and Sensors Handbook”, 2ndEdition, CRC Press - Taylor & Francis Group, LLC Boca Raton, Florida, 2017.

REFERENCES:

1	Subhas Chandra Mukhopadhyay, “Smart Sensors, Measurement and Instrumentation”, Springer Heidelberg, Germany, 2013.
2	Sunit Kumar Sen, “Fieldbus and Networking in Process Automation”, Taylor & Francis Group, LLC, London, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify different instrumentation systems and fundamentals of wireless technology	Understanding (K2)
CO2	indicate the power sources and energy storage units used for autonomous sensors	Understanding (K2)
CO3	recognize the different wireless protocols and network standards for wireless instruments	Understanding (K2)
CO4	illustrate design concepts and procedure for wireless devices and LoRA	Understanding (K2)
CO5	explore the various applications of wireless sensor and instrument systems and 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				1		1					2	2
CO2	3	1				1		1					2	2
CO3	3	1				1		1					2	2
CO4	3	1				1		1					2	2
CO5	3	1				1		1					2	2

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85					100
CAT2	15	85					100
CAT3	15	85					100
ESE	10	90					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**	**4,5,6,8**	**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 *sehr/zu*, 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 – *und, oder, aber*.		
Unit - IV	**Clothes and Style (Kleidung und mode) :**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative.		
Unit - V	**Health and Vacation (Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nichtdürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, ZumSchl*		

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.

REFERENCES:

1.	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware Refer: German 1 for undergraduate students
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	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														

ASSESSMENT PATTERN - THEORY							
Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	75					100
CAT2	25	75					100
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	4/5/6/8	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", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	MargheritaPezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	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)

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

ASSESSMENT PATTERN - THEORY

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

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

20GEO03 - DESIGN THINKING FOR ENGINEERS

(Offered by Department of Computer Science and Engineering)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	6	OE	3	0	0	3

Preamble	In this course, systematic process of thinking which empowers even the most traditional thinker to develop new, innovative solutions to the problem at handare studied with an emphasis on bringing ideas to life based on how real users think, feel and behave.	
Unit - I	**Introduction::**	**9**
Introduction – Need for design thinking – Design and Business – The Design Process – Design Brief –Visualization – Four Questions, Ten Tools – Explore – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.		
Unit - II	**Visualization:**	**9**
Introduction – Visualization – Journey Mapping – Value Chain Analysis – Mind Mapping – Empathize –Observations – Need Finding – User Personas.		
Unit - III	**Brainstorming:**	**9**
Introduction – Brainstorming – Concept Development – Experiment – Ideation – Prototyping – Idea Refinement.		
Unit - IV	**Assumption Testing:**	**9**
Introduction – Assumption Testing – Rapid Prototyping – Engage – Storyboarding.		
Unit - V	**Customer Co-Creation Learning Launch:**	**9**
Introduction – Customer Co-Creation Learning Launch – Leading Growth and Innovation – Evolve– Concept Synthesis – Strategic Requirements – Evolved Activity Systems – Quick Wins.		

Total:45

TEXT BOOK:

1. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.

REFERENCES:

1. Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017.
2. Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth FieldBook: A Step-by-Step Project Guide", Columbia University Press, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the basic concepts of design thinking	Understanding (K2)
CO2	make use of the mind mapping process for designing any system	Applying (K3)
CO3	develop many creative ideas through structured brainstorming sessions.	Applying (K3)
CO4	develop rapid prototypes to bring the ideas into reality	Applying (K3)
CO5	plan the implementation of the any system considering the real time feedback	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										
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	70	20				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	20	70				100

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

20GEO04 - INNOVATION AND BUSINESS MODEL DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	OE	3	0	0	3

Preamble	This course will inspire the students to think innovation concepts and ideas for business model developments.	
Unit - I	**Innovation and Design Thinking:**	**9**
Innovation and Creativity– Types of innovation – challenges in innovation- steps in innovation management- 7 concerns of design. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping		
Unit - II	**User Study and Contextual Enquiry:**	**9**
Explanatory research – primary and secondary data – classification of secondary data – sources of secondary data – qualitative research – focus groups – depth interviews – analysis of qualitative data – survey methods – observations- Process of identifying customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications		
Unit - III	**Product Design:**	**9**
Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction		
Unit - IV	**Business Model Canvas (BMC):**	**9**
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies		
Unit - V	**IPR and Commercialization:**	**9**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing		

Total:45

TEXT BOOK:

1.	Rishikesha T.Krishnan, “8 Steps To Innovation: Going From Jugaad To Excellence”, Collins India, 2013.

REFERENCES:

1.	Peter Drucker, “Innovation and Entrepreneurship”, Routledge CRC Press, London, 2014.
2.	Eppinger, S.D. and Ulrich, K.T. “Product design and development”, 7th Edition, McGraw-Hill Higher Education, 2020.
3.	Alexander Osterwalder, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st Edition, John Wiley and Sons; 2010.
4.	Indian Innovators Association, “Patent IPR Licensing – Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators”, Notion Press, Chennai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand innovation need and design thinking phases	Understanding (K2)
CO2	identify, screen and analyse ideas for new products based on customer needs	Analysing (K4)
CO3	develop and analyse the product concepts based on the customer needs and presents the overall architecture of the product.	Analysing (K4)
CO4	predict a structured business model for MVP	Applying (K3)
CO5	practice the procedures for protection of their ideas' IPR	Applying (K3)

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

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	40	10			100
CAT2	20	30	40	20			100
CAT3	30	30	40				100
ESE	20	30	30	20			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	**4/5/6/8**	**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	**Accomodation(Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Are you Working?(Arbeiten Sie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speakin about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style(Kleidung und mode):**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative		
Unit - V	**Health and Vacation(Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*		

Total: 60

TEXT BOOK:

1	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.

REFERENCES:

1	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand letters and simple texts	Remembering (K1)
CO2	assimilate vocabulary on Accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understand how to do shopping in a German store	Understanding (K2)
CO5	understand body parts and how to plan personal travel	Understanding (K2)

Mapping of COs with POs and PSOs

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

ASSESSMENT PATTERN - THEORY

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

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

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	**4/5/6/8**	**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.	
Unit - I	**All about food (Rund Ums Essen):**	**9**
Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'		
Unit - II	**School days (Nach der Schulzeit):**	**9**
Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.		
Unit - III	**Media in everyday life (Medien in Alltag):**	**9**
To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with 'Als' and 'Wie', Subordinate clause with 'dass', Superlative degree.		
Unit - IV	**Feelings and expressions (Gefühle):**	**9**
Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with 'Wenn', Adjectives to be used along with definite articles.		
Unit - V	**Profession and Travel (Beruf und Reisen):**	**9**
To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – 'werden', Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.		

Total: 45

TEXT BOOK:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.

REFERENCES:

1. Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (German)" , Goyal Publishers, Delhi, 2011.
2. https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand German food style, restaurant and be able express oneself.	Remembering (K1)
CO2	understand German school system and discuss about habits and provide City-Tipps.	Understanding (K2)
CO3	analyze and compare media in everyday life.	Understanding (K2)
CO4	express feelings, describe a city and write blog entries.	Understanding (K2)
CO5	seek and provide information in a professional setup, give directions to others and talk about travel.	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1								1	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														

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

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

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**	**4/5/6/8**	**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.	
Unit - I	**Learning (Lernen):**	**9**
Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ		
Unit - II	**Athletic (Sportlich):**	**9**
Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ		
Unit - III	**Living Together (Zusammen Leben):**	**9**
To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.		
Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**
Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ.		
Unit - V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**
Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.		

Total: 45

TEXT BOOK:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch", Goyal Publishers, Delhi, 2015.

REFERENCES:

1. Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2. https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	leverage learning in Workplace, understanding reports and make presentation.	Remembering (K1)
CO2	reciprocate to different situations, make appointment and understand texts.	Understanding (K2)
CO3	handle relationships and respond appropriately to exchange information	Understanding (K2)
CO4	familiarize to various channels of entertainment	Understanding (K2)
CO5	know about various cultural aspects, usage of proverbs and cliches.	Understanding (K2)

Mapping of COs with POs and PSOs

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

ASSESSMENT PATTERN - THEORY

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

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

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	4/5/6/8	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", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	differentiate groups of verbs and its forms	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script and If clause	Understanding (K2)
CO5	comprehend concept of “even if”, “when” and job-related information	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

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**	**4/5/6/8**	**HS**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life	
Unit - I	**Introduction to Potential verbs:**	**9**
Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.		
Unit - II	**Introduction to Transitive and Intransitive verbs:**	**9**
Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences-Conjunctions-Basic Questions and kanji's.		
Unit - III	**Introduction to Volitional forms:**	**9**
Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.		
Unit - IV	**Introduction to Imperative and Prohibitive verbs:**	**9**
Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.		
Unit - V	**Introduction to Conditional form and Passive verbs:**	**9**
Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)
CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

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**	**4/5/6/8**	**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", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)
CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Orally Presented Materials.	Understanding (K2)

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

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

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

20GEO11 - NCC Studies(Army Wing) – I
(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**5 / 6**	**OE**	**3**	**0**	**2**	**4**

Preamble	This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.	
Unit - I	**NCC Organisation and National Integration:**	**9**
NCC Organisation – History of NCC- NCC Organisation- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit - II	**Basic physical Training and Drill:**	**9**
Basic physical Training – various exercises for fitness(with Demonstration)-Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION)		
Unit - III	**Weapon Training:**	**9**
Main Parts of a Rifle- Characteristics of 5.56mm INSAS rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing(WITH PRACTICE SESSION) - Characteristics of 7.62mm SLR- LMG- carbine machine gun.		
Unit - IV	**Social Awareness and Community Development:**	**9**
Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility		
Unit - V	**Specialized Subject (ARMY):**	**9**
Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading including practical.		

Lecture :45, Practical:30, Total:75

TEXT BOOK:

1.	“National Cadet Corps- A Concise handbook of NCC Cadets”, Ramesh Publishing House, New Delhi, 2014.

REFERENCES:

1.	“Cadets Handbook – Common Subjects SD/SW”, published by DG NCC, New Delhi.
2.	“Cadets Handbook- Specialized Subjects SD/SW”, published by DG NCC, New Delhi.
3.	“NCC OTA Precise”, published by DG NCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders..	Applying (K3)
CO3	basic knowledge of weapons and their use and handling.	Applying (K3)
CO4	understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Applying (K3)
CO5	acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3	3	3	3	3				
CO2					3									
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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						

20GEO12 - NCC STUDIES (AIR WING) – I
(Offered by Department of Information Technology)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character , camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets.	
Unit – I	**NCC Organization and National Integration:**	**9**
NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honors' and Awards – Incentives for NCC cadets by central and state govt. History and Organization of IAF-Indo-Pak War-1971-Operation Safed Sagar. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit – II	**Drill and Weapon Training:**	**9**
Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION). Main Parts of a Rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing (WITH PRACTICE SESSION).		
Unit – III	**Principles of Flight:**	**9**
Laws of motion-Forces acting on aircraft–Bernoulli's theorem-Stalling-Primary control surfaces – secondary control surfaces-Aircraft recognition.		
Unit - IV	**Aero Engines:**	**9**
Introduction of Aero engine-Types of engine-piston engine-jet engines-Turboprop engines-Basic Flight Instruments-Modern trends.		
Unit – V	**Aero Modeling:**	**9**
History of aero modeling-Materials used in Aero-modeling-Types of Aero-models – Static Models-Gliders-Control line models-Radio Control Models-Building and Flying of Aero-models.		

Lecture :45, Practical30, Total:75

TEXT BOOK:

1	"National Cadet Corps- A Concise handbook of NCC Cadets" by Ramesh Publishing House, New Delhi,2014.

REFERENCES:

1	"Cadets Handbook – Common Subjects SD/SW" by DG NCC, New Delhi.
2	"Cadets Handbook – Specialised Subjects SD/SW" by DG NCC, New Delhi.
3	"NCC OTA Precise" by DGNCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Applying (K3)
CO3	illustrate various forces and moments acting on aircraft	Applying (K3)
CO4	outline the concepts of aircraft engine and rocket propulsion	Applying (K3)
CO5	design, build and fly chuck gliders/model airplanes and display static models.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3	3	3	3				
CO2					3									
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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						

20GEO13 - FRENCH LANGUAGE LEVEL 1

Programme & Branch	**All Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**5/6/7/8**	**HS**	**3**	**1**	**0**	**4**

Preamble	This course provides a foundation of the French language as well as an understanding of the French culture and lifestyle of France and other French-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications.	
Unit - I	**Introduction:**	**12**
French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem),Salutations, numbers.		
Unit - II	**Daily Life:**	**12**
Subject Pronoun, Francophonie’s, adjectives – colors, week, months, seasons.		
Unit - III	**Articles and Verbs:**	**12**
Articles - Indefinite, definite, partitive, and contracted, (examples), introductions to verbs, 1st group of verb		
Unit - IV	**In the City:**	**12**
2nd group of verbs, irregular verbs (avoir, etre, faire …..) present yourself & negative sentences. (faire and Jouer verb with the expressions)		
Unit - V	**Food and Culture:**	**12**
Prepositions – preposition of places (country, cities and etc), Imperative mode, invitations, culture – food (wine, cheese ….) Future (recent future)		

Total:60

TEXT BOOK:

1.	A1 – saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	ask for directions and arrange for transportation, etc,as needed.	Understanding (K2)
CO4	understand the food habits of France and ask for appointments	Understanding (K2)
CO5	learn to socialize in French-speaking countries	Understanding (K2)

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

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

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

20GEO14 - FRENCH LANGUAGE LEVEL 2

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of French Language	5/6/7/8	HS	3	1	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

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the French language in deep and its usage	Remembering (K1)
CO2	preparation of their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	know the difference between Past and Present and Compare them.	Understanding (K2)

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

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

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

20GEO15 - FRENCH LANGUAGE LEVEL 3

Programme& Branch	All Engineering courses	Sem.	Category	L	T	P	Credit
Prerequisites	**Fundamentals of French Language**	**5/6/7/8**	**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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	learn on Future tense.	Remembering (K1)
CO2	understand Permissions and Prohibitions.	Understanding (K2)
CO3	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)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20GEO16 - SPANISH LANGUAGE LEVEL 1

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Fundamentals of Spanish Language**	**5/6/7/8**	**HS**	**3**	**1**	**0**	**4**

Preamble	This course provides a foundation of the Spanish language as well as an understanding of the Spanish culture and lifestyle of Spain and other Spanish-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications.	
Unit - I	**Greetings and Good byes (Los Saludos y Despidirse):**	**12**
Greetings,Self-Introduction , Formal and Informal ways of introducing oneself and others, Alphabets& Numbers, Countries and Languages Spoken, Parts of Grammar – Noun, Personal Pronoun, Describe surroundings and its vocabulary		
Unit - II	**Vida Cotidiana (Daily Life):**	**12**
Time of the day, Days of the week, Months of the year, Seasons, Verb (To be, To Have), Adverbs, Likes and Dislikes, Personality and physical description, simple sentences		
Unit - III	**Friends and Family (Amigos y La Familia):**	**12**
Vocabulary of family, Animals, Professions, Parts of the body, Opinions on family cultures, Articles – Definite and Indefinite, Hobbies, Regular and Irregular verbs.		
Unit - IV	**In the City (En la Cuidad):**	**12**
Buildings in the city, Name of the places, asking for directions, Helping each other, Description of house and its components, Modes of Transport, Grammar - Possessive articles, prepositions		
Unit - V	**Food and Culture(La comida y cultura):**	**12**
Food (types and varieties) , shopping, ordering at a restaurant, inviting to parties, Roleplay (as diner and customer, salesman and customer…etc.) Past tense (all three tenses-Past Participle, Indefinite past and past imperfect- (to be and to have)		

Total:60

TEXT BOOK:

1.	Chicos Chicas Libro de Alumno nivel 1, Ma Angeles Palomino , edelsa, GRUPO DIDASCALIA, S.A., plaza cuidad de salta,3-28043 MADRID(ESPANA).

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	understand the food habits of Spain and Latin countries and ask for appointments	Understanding (K2)
CO5	learn to socialize in Spanish speaking countries	Understanding (K2)

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

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

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

20GEO17 - SPANISH LANGUAGE LEVEL 2

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of Spanish Language	5/6/7/8	HS	3	1	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 Todavia or No		
Unit - IV	**Likes and Views (Gustasyvistas):**	**12**
Favorite persons & things, Giving advices, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit - V	**Then** and Now(Antes y Ahora):	**12**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		

Total:60

TEXT BOOK:

1.	AULA INTERNACIONAL 2 (A2), Jaime Corpas, Agusin Garmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	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)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20GEO18 - SPANISH LANGUAGE LEVEL 3

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of Spanish Language	5/6/7/8	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.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	learn on Future tense.	Remembering (K1)
CO2	understand about Permissions and Prohibitions.	Understanding (K2)
CO3	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)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20GEO19 - ENTREPRENEURSHIP DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Economics and Management for Engineers	6	EC	3	0	0	3

Preamble	The purpose of this course to create entrepreneurial awareness among engineering students.	
Unit - I	**Entrepreneurship Concepts:**	**9**
Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation - Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship & Entrepreneurs - Characteristics of Entrepreneurs - Entrepreneurship Development in India		
Unit - II	**Entrepreneurial Ventures and opportunity assessment:**	**9**
New venture creation – Bootstrapping, Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture development stages - Models of market opportunity- Opportunity assessment: Critical Factors In Opportunity Assessment, Idea vs Opportunity, Evaluation process, Global opportunities for entrepreneurs.		
Unit - III	**Business Plan:**	**9**
Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process – Structure of a Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan formulation - Presentation of the Business Plan: The 'Pitch'- case studies		
Unit - IV	**Financing and accounting:**	**9**
Forms of entrepreneurial capital – Sources of Financial capital: debt financing- Commercial banks and other sources, equity financing: Initial Public offering (IPO), Private placement - Venture capitalists - Angel investors-New forms of financing: Impact investors, Micro-financing, Peer-to-Peer Lending, Crowd funding - Natural capital. Preparing Financial Budget, Break even analysis, Taxation-Direct and indirect taxes, Insolvency and Bankruptcy.		
Unit - V	**Small Business Management:**	**9**
Definition of Small Scale Industries: Strengths and Weaknesses, Sickness in Small Enterprises: Symptoms -Causes and remedies-Indian Startup Ecosystem – Institutions supporting small business enterprises, Business Incubators – Government Policy for Small Scale Enterprises - Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger, FDI and Sub-Contracting		

Total:45

TEXT BOOK:

1.	Donald F. Kuratko,"Entrepreneurship: Theory, Process, Practice", 11th Edition, Cengage Learning, Boston, 2020.

REFERENCES:

1.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha "Entrepreneurship", 11th Edition, McGraw Hill, Noida, 2020.
2.	Charantimath Poornima .M, "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
3.	Gordon E & Natarajan K, "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur	Applying (K3)
CO2	identify suitable entrepreneurial ventures and business opportunity	Applying (K3)
CO3	assess the components of business plan	Analyzing (K4)
CO4	appraise the sources of finance and interpret accounting statements	Applying (K3)
CO5	interpret the causes of sickness of small scale enterprises and its remedies	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	1	1		3	2		1
CO2	1	2	2	2		2	2	1	1		3	2		2
CO3	2	2	2	2	2	2	2	2	2	2	3	2		1
CO4	1	1	2	1		2	1	1	1	2	3	2		1
CO5	1	1	2	1		2	1	1	1	2	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	30	30	20			100
CAT3	30	30	40				100
ESE	20	30	40	10			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”, 1st Edition Cambridge University Press, 2019 for Units IV & V.

REFERENCES:

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2.	EthemAlpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning series)”, 4th Edition, MIT Press, USA, 2020.
3.	R. O. Duda, E. Hart, and D.G. Stork, "Pattern classification", 2nd Edition, John Wiley & Sons,2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of vector spaces.	Understanding (K2)
CO2	apply the concepts of linear mappings in machine learning.	Applying (K3)
CO3	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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	50	40				100
CAT2	10	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", 1st 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", 1st Edition, Springer, London, 2013, for Units IV & V.

REFERENCES:

1.	Douglas B West, "Introduction to Graph Theory", 2nd Edition, Pearson Education, New Delhi, 2002.
2.	Jonathan L. Gross and Jay Yellen, "Graph Theory and its Applications", 2nd Edition, CRC Press, New York, 2006.
3.	J.A.Bondy and U.S.R. Murty ,Graph Theory and Applications , 5th Edition, Elsevier Science Publishing Co., Inc., New York,1982.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand basic graph theoretic concepts.	Understanding (K2)
CO2	intrepret the concepts the concepts of tress and its types.	Applying (K3)
CO3	compute the Chromatic partition, Chromatic polynomial and Matching of a given graph.	Applying (K3)
CO4	identify the maximal flow in network by means of algorithms.	Applying (K3)
CO5	apply various graph theoretic algorithms to communication and network problems	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	1												
CO3	3	1												
CO4	3	2	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	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", 1st Edition, Packt Publishing Ltd, UK, 2016, for Units I, II.
2.	Mark Gardener, "Beginning R-The Statistical Programming Language",1st Edition, John Wiley & Sons Inc., USA, 2012 for Units III, IV & V.

REFERENCES:

1.	Seema Acharya, "Data Analytics using R", 1st Edition, McGraw Hill Education, Chennai, 2018.
2.	Norman Matloff, "The Art of R Programming", 1st Edition, No Starch Press, San Francisco, 2011.
3.	Paul Teetor, "R Cookbook", 1st Edition, O'Reilly Media, USA, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the basics of fundamentals of R.	Understanding (K2)
CO2	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

ASSESSMENT PATTERN - THEORY

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

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

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	**Divisibility Theory and Canonical Decompositions:**	**9**
Division algorithm- Base-b representations – number patterns – Prime and composite numbers – Fibonacci and Lucas numbers – Fermat numbers – GCD – Euclidean Algorithm – Fundamental theorem of Arithmetic – LCM.		
Unit - II	**Theory of Congruences:**	**9**
Basic concepts – Properties of congruences – Linear congruences – Solution of congruences – Fermat’s Little theorem – Euler’s theorem – Chinese remainder theorem.		
Unit - III	**Number Theoretic Functions:**	**9**
Introduction – Functions τ and σ – Mobius function – Greatest integer function – Euer’s Phi function – Euler’s theorem – Properties of Euler’s function – Applications to Cryptography.		
Unit - IV	**Primality testing and Factorization:**	**9**
Primality testing: Fermat’s pseudo primality test – Solvay-Strassen test – Miller-Rabin test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard’s Rho method – Quadratic sieve method.		
Unit - V	**Classical Cryptographic Techniques:**	**9**
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”, 2nd Edition, Academic Press, Elsevier, USA, 2007, for Units I,II,III.
2.	William Stallings, “Cryptography and Network Security: Principles and Practice”, 7th Edition, Pearson Education, New Delhi, 2019, for Units IV,V.

REFERENCES:

1.	Ivan Niven, Herbert S. Zukerman, Hugh L. Montgomery, "An Introduction to the Theory of Numbers”, Reprint Edition, John Wiley & Sons, New Delhi, 2008.
2.	Bernard Menezes, “Cryptography and Network Security”, Cengage Learning India, 1st Edition, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of divisibility and canonical decompositions	Understanding (K2)
CO2	obtain the knowledge in theory of congruences and solution of linear congruences.	Understanding (K2)
CO3	use different number theoretic function suitably in cryptography.	Applying (K3)
CO4	apply Primality test and factorisation algorithms to network security problems.	Applying (K3)
CO5	apply the suitable cryptographic techniques to handle real time security issues.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

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

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.

REFERENCES:

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2.	Gareth Williams, “Linear Algebra with Applications”, 9th Edition, Jones & Bartlett Publishers, Canada, 2017.

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

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	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", 10th Edition, Dorling Kindersley, Pvt. Ltd, Uttar Pradesh, 2016.

REFERENCES:

1.	Sharma J.K, "Operations Research – Theory and Applications", 4th Edition, Macmillan Publishers India Ltd, New Delhi, 2009.
2.	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 6th Edition, S.Chand and Co. Ltd., New Delhi, 2008.
3.	KantiSwarup, Gupta P.K. and Man Mohan, "Operation Research", 14th Edition, Sultan Chand & Sons, New Delhi, 2014.

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

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)**

20PHO01 - THIN FILM TECHNOLOGY

(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	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, 1st 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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Utilize the appropriate theory and models to comprehend the thin film growth process.	Applying (K3)
CO2	Apply the principle of vacuum pump to explain select methods to create vacuum and to make use of the principle of vacuum gauge to explain the measurement of vacuum by select methods.	Applying (K3)
CO3	Describe the deposition of thin films by select physical methods using the principle of working of respective methods.	Applying (K3)
CO4	Explain the deposition of thin films by select chemical methods using the principle of working of respective methods.	Applying (K3)
CO5	Make use of select characterization techniques to comprehend the properties of thin films and also to illustrate the various device applications of thin films.	Applying (K3)

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

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

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

20PHO02- HIGH ENERGY STORAGE DEVICES
(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	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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Utilize the appropriate concepts and models to comprehend the basics of energy storage systems.	Applying (K3)
CO2	Apply the principle of thermal and mechanical storage systems to explain the working and the recent advancements in thermal and mechanical storage systems.	Applying (K3)
CO3	Ultilize the principle of operation of magnetic storage systems, electro-optic 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)

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

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

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 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, 3rd Edition, Pearson Education, India, 2003 (Unit I)
2	Banwell C. N, McCash E. M, Choudhury H. K, Fundamentals of Molecular Spectroscopy, 5th Edition, Tata McGraw-Hill Publ., New Delhi, 2013 (Unit II-V)

REFERENCES:

1.	Holt D. B. and Joy D. C, SEM micro characterization of semiconductors, 1st Edition, Academic Press, New Delhi, 1989
2.	Willard H. H., Merritt L. L., John A Dean, and Settle Jr. F. A, Instrumental methods of Analysis 7th Edition, Wadsworth Publishing Company, United States, 1988
3.	Elton N. Kaufman, Characterization of Materials (Volume1&2), 2nd, Wiley-Interscience, New Jersey, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Apply the concept of X-ray diffraction to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO2	Determine the micro-structural parameters of materials and to perform surface analysis of materials using the concept of matter waves and electron microscopy.	Applying (K3)
CO3	Utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image recorded at atomic level using scanning tunneling microscopy.	Applying (K3)
CO4	Make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO5	Apply the theory of UV-Vis spectroscopy to comprehend the working of UV-Vis spectrophotometer.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	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	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.

REFERENCES:

1.	B.K. Sharma, Instrumental Method of Chemical Analysis, Krishna Prakashan Media (P) Ltd. 2019.
2.	Willard,H.H, Merritt,L.L, Dean,J.A, and Settle, F.A, “Instrumental methods of analysis” CBS Publishers & Distributors, 7 Ed, 2004.
3.	Kaur. H, “Instrumental Methods of Chemical Analysis”, XII Edition, Pragati prakashan, Meerat, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the basics of spectroscopy to understand the instrumentation of various spectral techniques	Understanding (K2)
CO2	apply the IR, Raman and NMR for quantitative analysis of the sample.	Applying (K3)
CO3	apply the various techniques for the better understanding of surface morphology	Applying (K3)
CO4	explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample	Understanding (K2)
CO5	illustrate the thermal analysis for the identification of thermal stability of the compounds	Understanding (K2)

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

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

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

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 Galvanic 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) intergrannular- chromium depletion theory, weld decay and knife line attack, (iv) stress - SCC mechanism, and fatique- Cavitation damage – Fretting damage, (v) stray current corrosion - causes and its control.		
Unit - 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,2nd Edition, Springer, 2017.

REFERENCES:

1.	R. Winston, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Revie 4th Edition, Wiley publisher, 2008.
2.	Fontanna, "Corrosion Engineering", (Materials Science and Metallurgy series), McGraw Hill international Ed., 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the mechanism, expression of rate of corrosion and importance of corrosion studies to familiarize for industrial needs.	Understanding (K2)
CO2	demonstrate the thermodynamics and kinetics of different models of corrosion with respect to the environment	Applying (K3)
CO3	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)

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

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

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

20CYO03 - CHEMISTRY OF COSMETICS IN DAILY LIFE
(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	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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the formulation of cosmetics products	Understanding (K2)
CO2	identify the structuring materials 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)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

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20CYO04 - CHEMISTRY OF NUTRITION FOR WOMEN HEALTH

(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	This course aims to provide knowledge for engineering students on components of health and fitness and the role of nutrition for women health.	
Unit - I	**Nutrition**	**9+3**
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		
Unit - II	**Role of women in national development**	**9+3**
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.		
Unit - III	**Women and health**	**9+3**
Disease pattern and reproductive health- Menopause – Hypothyroid- PCOD-Diabetes - Policies and programs for promoting maternal and child nutrition and health - Concept of small family - Methods of family planning - Merits and demerits.		
Unit - IV	**Nutrition during Lactation and for Infants**	**9+3**
Physiology and psychology of lactation, hormonal control, composition of colostrums and breast milk, nutritional requirements of a nursing mother, advantages of breast feeding, food and nutritional requirements for infants, weaning and supplementary foods for infants and immunization.		
Unit - V	**Physical fitness and nutrition**	**9+3**
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.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Make use of the knowledge of dietary sources in day to day life	Applying (K3)
CO2	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)

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														

ASSESSMENT PATTERN - THEORY

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

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

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**
Chemical Equations: Types of ions and radicals- oxidation and reduction-redox reactions - Balancing ionic equations. **Chemical Bonding:** Octet rule -Types of Chemical bond -Formation of Ionic and Covalent bond- Common Properties of ionic and covalent compounds- Differences between Ionic and covalent Compounds-Coordinate covalent bond- Coordination compounds – nomenclature and isomerism. Application in analytical chemistry.		
Unit – III	**Acids, Bases, Salts and Metallurgy:**	**9**
Acid- base theory – Bronsted- Lowry theory- conjugate acid-base- Lewis concept- HSAB- applications- pH scale- Importance of pH in everyday life-Salts-Classification of salts-Uses of salts. **Metallurgy:** Introduction-Terminologies in metallurgy-Differences between Minerals and Ores-Occurrence of metals- Metallurgy of Aluminum, Copper and Iron.		
Unit – IV	**Carbon and its Compounds:**	**9**
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". 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019, for Units- I, II, III, V.

REFERENCES:

1.	B.R. Puri, L.R. Sharma, Principles of Inorganic Chemistry, 33rd Edition, Vishal Publishing Co., 2020.
2.	Paula Bruise, "Organic Chemistry", 6th Edition, 8th Edition, Pearson Education, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the basic concept of periodic classification of elements to explain the periodic properties and reactivity series of s, p & d block elements.	Applying (K3)
CO2	utilize the concepts of chemical equation and bonding to solve the problems in balancing ionic equation and differentiate ionic and covalent compounds.	Applying (K3)
CO3	apply the concept of acid, base, salts and metallurgy to explain HSAB concepts, Importance of pH in everyday life, classification of salts and metallurgy of Al, Cu & Fe.	Applying (K3)
CO4	make use of the concept of carbon its compounds to explain bonding and classification of carbon compounds.	Applying (K3)
CO5	utilize the important terms and concepts of thermodynamics to explain the first law and second law of thermodynamics with examples.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

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**
Solid wastes: definition, sources, types, composition of solid waste- Solid waste management system: collection, separation, processing and transformation of solid waste – combustion, aerobic composting, vermicomposting, pyrolysis, landfill-classification, types, methods and control of leachate in landfills. Recycling of material found in municipal solid waste- recycling of paper and cardboard, recycling of plastics, recycling of glass.		
Unit - II	**HAZARDOUS WASTE MANAGEMENT**	**9**
Hazardous wastes: definition, nature and sources of hazardous waste, classification and characteristics of hazardous waste-chemical class of hazardous waste, 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**
E-Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal. **Biomedical Waste Management :** Introduction-definition –components of biomedical waste-waste generation –waste identification and waste control-waste storage-labeling and color coding-handling and transportation-waste treatment and disposal- autoclave, hydroclave , microwave treatments- chemical disinfection – sanitary and secure landfill.		
Unit - IV	**POLLUTION FROM MAJOR INDUSTRIES AND MANAGEMENT**	**9**
Introduction- sources and characteristics - waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Sugar, Petroleum refinery, fertilizer, 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 distributers, 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” 1st Edition, Butterworth-Heinemann, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the technical points that are required to set up a solid waste management system.	Applying (K3)
CO2	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)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE-638060

(AUTONOMOUS)

BOARD OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

DEGREE & PROGRAMME : **BE & EIE**

HONOURS DEGREE TITLE: **INTELLIGENT SENSOR TECHNOLOGY**

The following courses are identified to earn additional 18 credits to get a Honours degree with specialization in **INTELLIGENT SENSOR TECHNOLOGY**

S.No	Course Code	Course Title	Credits	Prerequisites	Semester
1.	20EIH01	Intelligent Building Automation	4	Transducers Engineering	5
2.	20EIH02	System on chip	3	Digital Logic Circuits	5
3.	20EIH03	Intelligent Technology in Industrial Automation	4	Transducers Engineering	6
4.	20EIH04	Embedded IoT	3	Microprocessor and Microcontroller	6
5.	20EIH05	Smart Sensors and Intelligent Instrumentation	4	Transducers Engineering	7
		TOTAL	**18**		

20EIH01 - INTELLIGENT BUILDING AUTOMATION							
Programme & Branch	**BE – Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transducers Engineering**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

Preamble	This course discusses about the wide variety of techniques available for all building automation areas such as energy, HVAC, information, transportation, safety, security, maintenance, and facility management. This course enables scientists and engineers engaged in research on and the development and application of sensors in the building control area	
Unit – I	**Building Automation System**	**9+3**
Introduction–Definitions of intelligent building – Facilities management vs intelligent buildings – Technology systems and evolution of intelligent buildings – Introduction to building automation System (BAS) –The progress of BAS –Programming and monitoring platforms and environment.		
Unit – II	**BAS Communication Standards and Internet Technologies**	**9+3**
BACnet and its features – Lon Works and its features– EIB and its features – Compatibility of different open protocol standards – Integration at management level – Internet protocols – use of Internet technologies at automation level – use of Internet technologies at management level – Convergence networks and total integration.		
Unit – III	**Lighting, Security and Safety Control Systems**	**9+3**
Introduction to lighting control systems – Systems based on common automation protocols–Strategies for energy management and lighting control – Basic CCTV components and analogue CCTV systems – IP surveillance system – Access control systems – Burglar alarm systems.		
Unit – IV	**Control and Optimization of Air- Conditioning Systems**	**9+3**
Typical control loops of the air- conditioning process – Control of CAV systems: Basic control of CAV systems, Sequential split range control of AHU – Control of VAV systems: Control of VAV air handling units, VAV terminal and room temperature control – Outdoor air ventilation control and optimization – Optimal control methods used for HVAC systems – Optimal control of air side systems.		
Unit – V	**Control and Optimization of Central Chilling Systems**	**9+3**
Basic working principles – Basic components and typical types – Chiller capacity control and safety interlocks – Chiller energy performance – Optimal control of central chilling systems – Optimal set point reset of chilled water supply temperature – Sequence control of multiple chiller plants: Temperature based sequence control, Bypass flow based sequence control.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Shengwei Wang, “Intelligent Buildings and Building Automation”, 1st Edition, Spon Press (an imprint of the Taylor & Francis Group), 2010.

REFERENCES:

1.	O. Gassmann, H. Meixner, "Sensors in Intelligent Buildings", 1st Edition, Wiley-VCH Verlag GmbH, Germany, 2001.
2.	NJATC, "Building Automation Control Devices and Applications", 1st Edition, American Technical Publishers, 2008.
3.	Singh S. K., ‘Industrial Instrumentation and Control’, 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	describe the functions intelligent building automation system	Understanding (K2)
CO2	summarize the need of BAS Communication Standards and Internet Technologies	Understanding (K2)
CO3	explain the different lighting, safety and security systems in building automation	Understanding (K2))
CO4	interpret the various Control and Optimization of Air- Conditioning Systems	Applying (K3)
CO5	illustrate the various Control and Optimization of Central Chilling 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											2	2
CO2	3	2											2	2
CO3	3	3	1	1	1								2	2
CO4	3	3	1	1	1								3	3
CO5	3	3	1	1	1								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	25	75					100
CAT2	30	70					100
CAT3	10	40	50				100
ESE	20	50	30				100

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

20EIH02 - SYSTEM ON CHIP

Programme & Branch	**BE – Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Logic Circuits**	**5/6/7**	**HN**	**3**	**0**	**0**	**3**

Preamble	To infer the concepts of hardware and software with the communication, design flow, subsystems and methodologies on a chip	
Unit – I	**System-on-Chip:**	**9**
The System-on-Chip Concept -The Cast of Players- SoC Interfaces for Custom Hardware-Four Design Principles in SoC Architecture-Heterogeneous and Distributed Data Processing-Heterogeneous and Distributed Communications-Heterogeneous and Distributed Storage-Hierarchical Control.		
Unit – II	**Principles of Hardware/Software Communication**:	**9**
Connecting Hardware and Software-Synchronization Schemes-Synchronization Concepts-One-Way and Two-Way Handshake-Blocking and Non-blocking Data-Transfer-Tight and Loose Coupling. Introduction to Bus.		
Unit – III	**VLSI Sub Systems**:	**9**
Introduction- single bit addition-carry propagate addition-subtraction- multiplier input addition-Magnitude comparators-Binary counters-Serial Multiplication-low power Static RAMs.		
Unit – IV	**VLSI Design Flow :**	**9**
Introduction to Integrated Circuits-Pre-RTL Methodologies-RTL to GDS Implementation Flow-Verification Techniques-Testing Techniques-Post-GDS Processes. Chip Planning –Placement-Routing-Physical Verification and Signoff-Post-silicon Validation.		
Unit – V	**Design Methodologies**:	**9**
Microprocessor / DSPs –Programmable Logics-gate Array and Sea of Gate arrays-Cell based Design-Full Custom Design-Platform based Design-System on Chip. Mixed Signal and Custom Design Flow. Example: Portable Multimedia System- Network On Chip.		
		Total:45

TEXT BOOK:

1.	Patrick Schaumont, “ A Practical Introduction to Hardware/Software Co-design”, 2nd Edition, Springer, New York, 2012.

REFERENCES:

1.	Sneh Saurabh, “Introduction to VLSI Design Flow”, Cambridge University Press, England, 2023
2.	Neil H.E.Waste and David Money Harris,”CMOS VLSI Design - A Circuits and Systems Perspective”, 4th Edition, Addison Wesley, Boston, 2011.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	recall the basic concepts of System on Chip	Understanding (K2)
CO2	acquire the knowledge of the communication architectures used in System on Chip	Understanding (K2)
CO3	apply data path logic to design combinational and sequential circuits	Applying(K3)
CO4	make use of the design flow for design of high performance circuits	Applying(K3)
CO5	explain the Various design methodologies for Chip design	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

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

20EIH03 - INTELLIGENT TECHNOLOGY IN INDUSTRIAL AUTOMATION

Programme & Branch	BE – Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Transducers Engineering	5/6/7	HN	3	1	0	4

Preamble	To impart the significance of intelligent techniques in measurements and automation.

Unit – I Modeling and Linearization of Intelligent Sensors: 9+3

Introduction –classification –smart sensors-cogent sensors – soft sensors-rough set theory – model structures: ARMAX model-artificial neural network model. Self adapting sensors - Self validating sensors: functional validation –applications. Linearization of positive and negative coefficient resistive sensors - amplifier based linearization-interpolation- piecewise linearization-artificial neural network based linearization – non-linear adaptive filter based linearization.

Unit – II Intelligent Technology in Signal Analysis : 9+3

Introduction – types of test and metering instruments – example of intelligent instrument – structure principle of data acquired system –simulation of ADC -noise analysis technology –noise simulation model –weak signal detection. Measurement uncertainty – data processing algorithms – inverse problem and its processing – methodologies in intelligent instrument design – intelligent computing – accuracy design theory – software test – reliability engineering in intelligent instrument.

Unit – III Arduino and MATLAB in Intelligent Instrument: 9+3

MATLAB in intelligent Instrument: Predictive maintenance - computer vision – robotics system- Arduino in intelligent Instrument: SLAM –PHM – IoT in intelligent instrument: power instrument in IoT - vector network analyser in IoT –Data communication technology: IIC bus –SPI bus – EPA bus- blue tooth communication technology in IoT. Foundational design using Proteus: 7 segment LED and matrix key design – IoT design by Proteus.

Unit – IV Sensors with Artificial Intelligence: 9+3

Introduction -Multi dimensional intelligent sensors- AI for prognostic instrumentation – ANN based intelligent sensors –fuzzy logic based intelligent sensors- intelligent sensors standards and protocols:IEEE 1451 standard –CEBUS communication protocol for smart home –J1850 Bus – MI bus-plug-n-play smart sensor protocol.

Unit – V Applications of Intelligent Sensor Technology: 9+3

State –of -the- art instruments of Siemens, Honeywell and ABB – fault tolerance of condition monitoring – fault analysis and diagnosis. Wearable intelligent instrument – bio-potential measurements – Mobile robot –smart car –smart UAV.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Manabendra Bhuyan , "Intelligent Instrumentation –Principles and Applications", CRC Press-Taylor &Francis group, 1st Edition, 2011
2.	Chang Jian Deng, "Modern Intelligent Instruments – Theory and Applications", Bentham Science Publishers Pvt. Ltd, Singapore, 1st Edition, 2020.

REFERENCES:

1.	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd Edition, Prentice Hall, 2003.
2.	Sudip Misra, Chandana Roy, Anandarup Mukherjee," Introduction to Industrial internet of things and industry 4.0", 1st Edition, CRC press, 2021.
3.	Rich and Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop modelling of instrument using intelligent technologies	Applying (K3)
CO2	apply the intelligent technologies for analyzing the signal	Applying (K3)
CO3	interface MATLAB and Arduino for intelligent sensor technology and communication	Applying (K3)
CO4	understand the applications of artificial intelligence and its protocols in sensor technology	Understanding (K2)
CO5	understand the recent trends in intelligent sensor technology in industrial applications	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

<table>
<tr><td colspan="8">20EIH04 - EMBEDDED IOT</td></tr>
<tr><td>Programme & Branch</td><td>BE – Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Microprocessor and Microcontroller</td><td>5/6/7</td><td>HN</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Preamble</td><td colspan="7">To impart basic principles and concepts on Internet of Things technologies and its role in real time applications</td></tr>
<tr><td>Unit – I</td><td colspan="6">Fundamentals and Applications of IoT:</td><td>9</td></tr>
<tr><td colspan="8">Introduction to Internet of Things (IoT) – Characteristics – IoT architecture – Architecture Layers – Functional components of IoT – IoT Technology Fundamentals – Challenges of IoT – Introduction to IIoT and its requirements.</td></tr>
<tr><td>Unit – II</td><td colspan="6">IoT Network Protocols and Communication:</td><td>9</td></tr>
<tr><td colspan="8">Infrastructure protocol: Internet Protocol Version 6, Data protocols: Message Queue Telemetry Transport – Constrained Application Protocol – Advanced Message Queuing Protocol. Connectivity Technologies: RFID – ZigBEE – Bluetooth – Near Field Communication – Wireless HART – Z–Wave – 6 LoWPAN – LoRaWAN.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Sensor Networks and Cloud Computing:</td><td>9</td></tr>
<tr><td colspan="8">Wireless Sensor Networks – Sensor Nodes – Software Defined Networking. Machine to Machine Communication. Cloud Computing Fundamental: Components and Cloud Models – Service Model – Service Management and Security.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">IoT Physical Devices and End Points :</td><td>9</td></tr>
<tr><td colspan="8">Review of Python Programming – Raspberry Pi Basic Architecture – Pin Configuration – Accessing GPIO – Remote Data Logging – Integration of Sensors and Actuators with Raspberry Pi – LED, Camera, Temperature and Humidity Sensor Interfacing.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Applications of IoT:</td><td>9</td></tr>
<tr><td colspan="8">Smart Cities and Smart Homes Monitoring, Weather Monitoring System, Agriculture: Smart water management system, Remote Healthcare Monitoring System, Smartphone based Monitoring system (Only Block diagram Approaches)</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Misra, S., Mukherjee, A., & Roy, A, “Introduction to IoT”, 1st Edition, Cambridge: Cambridge University Press. 2021. (Unit I,II, III, IV,V)</td></tr>
<tr><td>2.</td><td colspan="7">Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands–on approach”, 1st Edition, Universities Press, 2015. (Unit III, IV)</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Olivier Hersent, David Boswarthick and Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, John Wiley and Sons Limited, UK 2012.</td></tr>
<tr><td>2.</td><td colspan="7">Arora, Sumeet, Ramachandra Gambheer, and Meenakshi Vohra, “Design of Secure IoT Systems: A Practical Approach Across Industries”, 1st Edition, McGraw Hill, New York, 2021.</td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the basic concepts of IoT and its present developments	Understanding (K2)
CO2	understand IoT communication protocols for Interfacing	Understanding (K2)
CO3	acquire knowledge about sensor networks and Cloud Computing	Understanding (K2)
CO4	implementation on IoT Physical Devices and sensor interfacing	Applying (K3)
CO5	recognize IoT applications and control	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	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	1											2	2

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

ASSESSMENT PATTERN - THEORY

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

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

20EIH05 - SMART SENSORS AND INTELLIGENT INSTRUMENTATION

Programme & Branch	**BE – Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transducers Engineering**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

Preamble	This course enhances the students to understand all the processes involved in the industries, the various unit operations and be able to apply control schemes to these processes to get the output with desired specifications	
Unit – I	**Basics of Smart Sensors and Micromachining:**	**9+3**
Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques. Case study to build smart sensors.		
Unit – II	**MCUs and DSPs for Sensor:**	**9+3**
Introduction, MCU control, MCUs for sensor interface: Peripherals, Memory, Input / Output, Onboard ADC, Power saving capability, Local voltage or current regulation, Modular MCU design. DSP control, Software, tools and support, sensor integration. Case study for building smart sensors with MCUs and DSPs.		
Unit – III	**Sensor Communication and MEMS:**	**9+3**
Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Micro optics, micro-grippers, micro-probes, micro- mirrors, FEDs, communications for smart sensors - sources and standards, automotive protocols, industrial networks, office and building automation, home automation, protocols in silicon, other aspects of network communications.		
Unit – IV	**Packaging, Testing and Reliability of Smart Sensors:**	**9+3**
Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors. Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.		
Unit – V	**Implications of Smart Sensor Standards and Recent Trends:**	**9+3**
Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Randy Frank, “Understanding Smart Sensors”, 2nd Edition, Artech House Publications, 2013.
2.	Youn-Long Lin, “Smart Sensors and Systems”, Springer Nature, 2015

REFERENCES:

1.	G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, “Micro and Smart Systems: Technology and modeling”, Willey Publications, 2012.
2.	Krzysztof Iniewski, “Smart Sensors for Industrial Applications”, CRC Press, 2013.
3.	Santhosh K V, “Smart Sensors Measurements and Instrumentation”, Lecture Notes in Electrical Engineering, Springer Nature, 2021.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the principle of smart sensors and process of micromachining in development of smart sensors.	Applying (K3)
CO2	apply the intelligent systems by interfacing the smart sensors to MCUs and DSPs.	Applying (K3)
CO3	apply the use of smart sensors in communication, MEMS and automation	Applying (K3)
CO4	explain the standards of smart sensors by the assessment of reliability testing and packaging	Understanding (K2)
CO5	discuss the applications of smart sensors in different fields and recent development.	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

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