KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

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

KONGU
Assuring the Best

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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, 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, 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:

S. No.	Specializations for Honours degree in emerging areas	To be offered as Honours, Only for the following branches mentioned against the specialization
1.	Construction Technology	Civil Engineering
2.	Robotics	Mechanical Engineering
3.	Electric Vehicles	Mechanical Engineering
4.	Artificial Intelligence and Machine Learning	Mechatronics Engineering
5.	Electric Vehicles	Automobile Engineering
6.	Artificial Intelligence and Machine Learning	Electronics and Communication Engineering
7.	Electric Vehicles	Electrical and Electronics Engineering
8.	Control Systems and Sensors Technology	Electronics and Instrumentation Engineering
9.	Cyber Security	Computer Science and Engineering
10.	Data Science	Computer Science and Engineering
11.	Cyber Security	Information Technology
12.	Data Science	Information Technology
13.	Waste Technology	Chemical Engineering
14.	Food Processing and Management	Food Technology

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, comprehensive test & viva, internship and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills 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 course 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 or Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

4.3.2 Comprehensive Test & 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 projects 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 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 1 / Industrial Training / Mandatory Course</td><td>100</td><td>---</td></tr>
<tr><td>4.</td><td>Project Work 2 Phase I / Project Work 2 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</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:

Sl. No.	Type	Max. Marks	Remarks
1.	Test - I	30	Average of best two
	Test - II	30	
	Test - III	30	
2.	Tutorial	15	Should be of Open Book/Objective Type. Average of best 4 (or more, depending on the nature of the course, as may be approved by Principal)
3.	Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
	Total	50	Rounded off to the one decimal place

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

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

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

7.4 Theory cum Practical Courses

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

7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 50 marks and the end semester examination shall be for 50 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidate's records shall be maintained.

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

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

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

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

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

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

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

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

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

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

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

7.7 Project Work I Phase I / Industrial Training

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

Continuous Assessment (Max. 100 Marks)								
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max.. 30 Marks)		Review III (Max. 50 Marks)		
						Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)	
Review 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 the Principal.

7.9 Comprehensive Test/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 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. The induction training program includes the courses recommended by AICTE. Apart from this induction program, a candidate shall undergo the courses listed by AICTE as mandatory courses during their programme. 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, but the grade awarded shall be only the lowest passing grade irrespective of the marks secured.

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.

The candidates who have failed in the courses Professional Skill Training I/II and Comprehensive Test/Viva shall be permitted to take up supplementary examinations.

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**	**3**	**7**	**18**	**10.65**
MC										
Semester wise Total	**22**	**22/23**	**23/22**	**24**	**22**	**22**	**21**	**13**	**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	0	0	0	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 & 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	0	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.	20EIT12	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 1 / Industrial Training 1	-	-	-	2	V
2.	20EIP61	Project Work 1	0	0	6	2	VI
3.	20GEL61 /20GEI61	Professional Skills Training 2 / Industrial Training 2	---	---	---	2	VI
4.	20EIP71	Project Work 1 Phase I	0	0	12	4	VII
5.	20GEL71	Comprehensive Test / Viva	-	-	-	2	VII
6.	20EIP81	Internship / Project work 2 Phase II	---	---	18	6	VIII
		Total Credits to be earned				**18**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	20EIT11	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	Neural Networks and Deep Learning	3	1	0	4	IV
2.	20EIO02	Digital Image Processing and Its Applications	3	1	0	4	IV
3.	20EIO03	Industrial Automation	3	1	0	4	V
4.	20EIO04	Measurements and Instrumentation	3	1	0	4	V
5.	20EIO05	Biomedical Instrumentation and Applications	3	0	0	3	VI
6.	20EIO06	PLC Programming and Its Applications	3	0	0	3	VI
7.	20EIO07	Instrumentation for Industry 4.0	3	0	0	3	VI
8.	20EIO08	Graphical Programming using Virtual Instrumentation	3	0	0	3	VIII
9.	20EIO09	Testing of Materials	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)

	Course Code	Course Name	L	T	P	C	OFFERED BY
		SEMESTER V					

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

S.No.	Course Code	Course Title	L	T	P	C	Offering Department	Semester
1.	18GEO01	German Language Level 1	4	0	0	4	ECE	V/ VI/ VII/ VIII
2.	18GEO02	Japanese Language Level 1	4	0	0	4	ECE	V/ VI/ VII/ VIII
3.	18GEO03	Design Thinking for Engineers	3	0	0	3	CSE	VI
4.	18GEO04	Innovation and Business Model Development	3	0	0	3	MTS	VIII
5.	18GEO05	German Language Level 2	4	0	0	4	ECE	V/ VI/ VII/ VIII
6.	18GEO06	German Language Level 3	3	0	0	3	ECE	V/ VI/ VII/ VIII
7.	18GEO07	German Language Level 4	3	0	0	3	ECE	V/ VI/ VII/ VIII
8.	18GEO08	Japanese Language Level 2	4	0	0	4	ECE	V/ VI/ VII / VIII
9.	18GEO09	Japanese Language Level 3	3	0	0	3	ECE	V/ VI/ VII / VIII
10.	18GEO10	Japanese Language Level 4	3	0	0	3	ECE	V/ VI/ VII / VIII
11.	18GEO11	NCC Studies (Army Wing) – I	3	0	2	4	EEE	V/ VI
12.	18GEO12	NCC Studies (Air Wing) – I	3	0	2	4	IT	V / VI

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-Circuit Theory (3-1-0-4)	20EIT12-Electron Devices and circuits (3-0-0-3)	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 1 Phase I (0-0-4-2)	20GEL61-Professional Skills Training/ 20GEI61-Ind. Training (0-0-0-2)	20GEP61-Comprehensive Test / Viva-(0-0-0-2)	22
VII	20GET71-Engineering Economics & Management (3-0-0-3)	20EIT51-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-2 phase-I (0-0-6-3)				21
VIII	Open Elective – 4 (3-0-0-3)	Professional Elective -6 (3-0-0-3)	20EIP81 Internship / Project work 2 Phase II (0-0-14-7)								**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	Circuit Theory	✓	✓	✓	✓	✓								✓	✓
1	20EIT12	Electron Devices and Circuits	✓	✓	✓	✓	✓								✓	✓
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 Lab									✓	✓		✓	✓	✓
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	Internship / Project work 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		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	Multisensor 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	20EIO01	Neural Networks and Deep Learning	✓	✓	✓	✓	✓							✓	✓
4	20EIO02	Digital Image Processing and Its Applications	✓	✓										✓	✓
6	20EIO03	Industrial Automation	✓	✓	✓	✓	✓							✓	✓
	20EIO04	Measurements and Instrumentation	✓	✓	✓	✓	✓							✓	✓
6	20EIO05	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓							✓	✓
7	20EIO06	PLC Programming and Its Applications	✓	✓	✓	✓	✓							✓	✓
7	20EIO07	Instrumentation for Industry 4.0	✓	✓	✓	✓	✓							✓	✓
8	20EIO08	Graphical Programming using Virtual Instrumentation	✓	✓	✓	✓	✓							✓	✓
8	20EIO09	Testing of Materials	✓	✓	✓	✓	✓							✓	✓

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020

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	Circuit Theory	3	1	0	4	50	50	100	PC
20EIT12	Electron Devices and Circuits	3	0	0	3	50	50	100	ES
Practical / Employability Enhancement									
20EIL11	Circuits and Devices Laboratory	0	0	2	1	100	0	100	ES
20PHL11	Physical Sciences Laboratory I	0	0	2	1	100	0	100	BS
Mandatory Non Credit									
20MNT11	Induction Training 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	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/ 20CSC31	Transducers Engineering* / Programming in C#	3	0	0/2	3/4	50	50	100	PC/ES
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
Practical / Employability Enhancement									
20MEL11	Engineering Practices Laboratory	0	0	2	1	100	0	100	ES
20PHL26	Physical Sciences Laboratory II	0	0	2	1	100	0	100	BS
20VEC11	Yoga and Values for Holistic Development	0	0	0	1	100	0	100	HS
Total Credits to be earned					**22/23**				

*2020 batch, # 2021 batch

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020

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/ 20CSC41	Programming in C* / Python Programming#	3	0	2	4	50	50	100	ES
20EIT31/ 20EIT21	Networks, Signals and Systems*/ Transducers Engineering#	3	1/0	0	4/3	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	100	0	100	HS
20EIL31	Transducers and Measurements Laboratory	0	0	2	1	100	0	100	PC
20EIL32	Analog Integrated Circuits Laboratory	0	0	2	1	100	0	100	PC
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**23/22**				

*2020 batch, # 2021 batch

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/ 20EIT31	Python Programming*/ Networks, Signals and Systems#	3	0/1	2/0	4	50	50	100	ES/ PC
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 - 1	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	100	0	100	PC
Mandatory Non Credit									
20MNT31	Environmental Science	2	0	0	0				MC
Total Credits to be earned					**24**				

*2020 batch, # 2021 batch

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-1	3	0	0	3	50	50	100	PE
	Open Elective 2	3	0/1	2/0	4	50	50	100	OE
Practical / Employability Enhancement									
20EIL51	Electrical Machines and Control Laboratory	0	0	2	1	100	0	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 1 / Industrial Training 1	--	--	--	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 3	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 1	0	0	4	2	100	0	100	EC
20GEL61/ 20GEI61	Professional Skills Training 2 / Industrial Training 2	---	---	---	2	100	0	100	EC
20GEP61	Comprehensive Test / Viva	0	0	0	2	100	0	100	EC
Total Credits to be earned					**22**				

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2020

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 2	3	0	0	3	50	50	100	PE
	Professional Elective 3	3	0	0	3	50	50	100	PE
	Professional Elective 4	3	0	0	3	50	50	100	PE
	Professional Elective 5	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20EIP71	Project Work II Phase I	0	0	6	3	50	50	100	EC
Total Credits to be earned					**21**				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
	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	Internship / Project work 2 Phase II	0	0	14	7	50	50	100	EC
Total Credits to be earned					**13**				

Total Credits: 169

PROFESSIONAL ELECTIVE (PE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
		Elective - I					
1.	20EIE01	Biomedical Instrumentation	3	0	0	3	V
2.	20EIE02	Embedded Systems	3	0	0	3	V
3.	20EIE03	Soft Computing Techniques	3	0	0	3	V
4.	20EIE04	Piping and Instrumentation Diagrams	3	0	0	3	V
5.	20EIE05	Industrial Electronics and Drives	3	0	0	3	V
6.	20EIE06	Advanced Control Theory	3	0	0	3	V
		Elective - II					
7.	20EIE07	Analytical Instrumentation	3	0	0	3	VI
8.	20EIE08	Instrumentation System Design	3	0	0	3	VI
9.	20EIE09	Digital Image Processing	3	0	0	3	VI
10.	20EIE10	Power Plant Instrumentation	3	0	0	3	VI
11.	20EIE11	Wireless Instrumentation	3	0	0	3	VI
12.	20EIE12	Advanced PID Control	3	0	0	3	VI
13.	20GEE01	Fundamentals of Research	3	0	0	3	VI
		Elective - III					
14.	20EIE13	Fiber Optics and Laser Instruments	3	0	0	3	VII
15.	20EIE14	Wearable Technology	3	0	0	3	VII
16.	20EIE15	Deep Neural Networks for Computational Imaging	3	0	0	3	VII
17.	20EIE16	Instrumentation Techniques in Agriculture	3	0	0	3	VII
18.	20EIE17	Industrial Internet of Things	3	0	0	3	VII
19.	20EIE18	Optimal and Adaptive Control	3	0	0	3	VII
20.	20EIE19	Total Quality Management	3	0	0	3	VII
		Elective - IV					
21.	20EIE20	Safety in Process Industries	3	0	0	3	VII
22.	20EIE21	VLSI Systems	3	0	0	3	VII
23.	20EIE22	MEMS and Nano Technology	3	0	0	3	VII
24.	20EIE23	Instrumentation in Aircraft Navigation and Control	3	0	0	3	VII
25.	20EIE24	Machine Learning and Its Applications	3	0	0	3	VII
26.	20EIE25	Control System Components	3	0	0	3	VII
		Elective - V					
27.	20EIE26	Multi Sensor Data Fusion	3	0	0	3	VII

28.	20EIE27	Electronic Instrumentation	3	0	0	3	VII
29.	20EIE28	Artificial Intelligence	3	0	0	3	VII
30.	20EIE29	Instrumentation and Control in Process Industries	3	0	0	3	VII
31.	20EIE30	Intelligent Robotic Systems	3	0	0	3	VII
32.	20EIE31	Computer Control of Processes	3	0	0	3	VII
		Elective - VI					
33.	20EIE32	Diagnostic and Therapeutic Instruments	3	0	0	3	VIII
34.	20EIE33	3D Printing Hardware	3	0	0	3	VIII
35.	20EIE34	Neuroimaging for Data Analysis	3	0	0	3	VIII
36.	20EIE35	Instrumentation and Control in Petro Chemical Industries	3	0	0	3	VIII
37.	20EIE36	VHDL Programming and Its Applications	3	0	0	3	VIII
38.	20EIE37	Model Predictive Control	3	0	0	3	VIII
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	Neural Networks and Deep Learning	3	1	0	4	IV
2.	20EIO02	Digital Image Processing and Its Applications	3	1	0	4	IV
3.	20EIO03	Industrial Automation	3	1	0	4	V
4	20EIO04	Measurements and Instrumentation	3	1	0	4	V
5.	20EIO05	Biomedical Instrumentation and Applications	3	0	0	3	VI
6.	20EIO06	PLC Programming and Its Applications	3	0	0	3	VI
7.	20EIO07	Instrumentation for Industry 4.0	3	0	0	3	VI
8.	20EIO08	Graphical Programming using Virtual Instrumentation	3	0	0	3	VIII
9.	20EIO09	Testing of Materials	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

TE**XT 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–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)**

20EIT12–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.		

Lecture:45, 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**

20EEL11– 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
(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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		13	30	33	-	17	100
CAT2		13	33	37	-	17	100
CAT3		20	30	33	-	17	100
ESE		6	40	36	-	18	100

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

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

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

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

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.		

Lecture:45, Tutorial:15, Total:60

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)

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. (Unit 1&2)
2	NagoorKani A., "Signals and Systems", McGraw Hill Education(India) Pvt. Ltd., New Delhi, 2010. (Unit 3,4&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.		

Lecture:45, Total:45

TEXT BOOK:

1	Roy Choudhry D. and Shail Jain," Linear Integrated Circuits" 4thEdition ,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**.**		

Lecture:45, 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", 3rdedition,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

(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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.	Lab 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

(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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 & Technology branches except CSE, IT)

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

Preamble	This course introduces the core python programming. It emphasizes on developing python programs with all data types, functions, classes, objects and numpy	
Unit - I	**Introduction:**	**9**
Introduction: Problem solving strategies – program design tools – Types of errors – Testing and Debugging- Basics: Literals – variables and identifiers – data types - input operation – comments – reserved words – indentation – Operators and Expressions – Decision Control Statements:Introduction – conditional statement – iterative statements – Nested Loops – break,continue and pass statements – else in loops.		
Unit - II	**Lists,Tuples and Dictionary:**	**9**
Lists,Tuples and Dictionary:Lists:Access, update, nested, cloning, operations, methods , comprehensions, looping - Tuple:Create, utility, access, update, delete, operations, assignments, returning multiple values, nested tuples, index and count method - Dictionary: Create, access, add and modify, delete, sort, looping, nested, built-in methods – list vs tuple vs dictionary.		
Unit - III	**Strings and Regular Expressions:**	**9**
Strings and Regular Expressions:Strings:Concatenation , append, multiply on strings – Immutable – formatting operator – Built-in string methods and functions – slice operation – functions – operators – comparing – iterating – string module – Regular Expressions – match, search, sub, findall and finditer functions – flag options.		
Unit - IV	**Functions and Modules:**	**9**
Functions and Modules: Functions:Introduction - definition – call – variable scope and lifetime – return statement – function arguments – lambda function – documentation strings – programming practices recursive function- Modules:Modules – packages – standard library methods – function redefinition.		
Unit - V	**Object Orientation, NumPy and Matplotlib:**	**9**
Object Orientation: Class and Objects:Class and objects – class methods and self – constructor – class and object variables – destructor – public and private data member.NumPy :NumPy Arrays – Computation on NumPy Arrays. Matplotlib : Line plots – Scatter Plots		

List of Exercises / Experiments :

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

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1. Reema Thareja, "Python Programming using Problem Solving Approach", 3rd Edition, Oxford University Press, 2017.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of basic python constructs to write simple programs.	Applying (K3)
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 class and object and apply inheritance in programming.	Applying (K3)
CO6	implement the basic data types and control statements.	Applying (K3), Manipulation (S2)
CO7	demonstrate functions, regular expressions and object oriented concepts.	Applying (K3), Manipulation (S2)
CO8	perform numpy operations and analyse results using matplotlib	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	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										
CO6	3	2	1	1										
CO7	3	2	1	1										
CO8	3	2	1	1										
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

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

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

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		

Lecture:45, 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, vibration and shock 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				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.		

Lecture:45, 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
(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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.	LaboratoryManual
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", 7thEdition , 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)		

Lecture:45, 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", 8thEdition, McGraw Hill Education (India) Pvt. Ltd., New Delhi,2013.
2.	Senthil Kumar N., Saravanan M., & Jeevananthan S., "Microprocessor and Microcontroller", 12thImpression, 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.		

Lecture:45, 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
(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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, dew point 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
(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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.		

Lecture:45, Total:45

TEXT BOOK:

1	Krishnaswamy K.," Process Control", 2nd Edition(Reprint), New Age International (P) Ltd., Publishers,New Delhi, 2015. (Unit 1,3&4)
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. (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 and Fast Fourier Transforms**	**9+3**
Discrete Time Fourier Transform (DTFT), Properties of DFT – Fast Fourier Transform: Radix-2 FFT – Decimation in Time (DIT) algorithm – Decimation in Frequency (DIF) algorithm. Computing an inverse DFT by doing a direct FFT.		
Unit - II	**Finite Impulse Response (FIR) Filters**	**9+3**
Magnitude response and phase response of digital filters – Frequency response of linear phase FIR filters – Design techniques for FIR filters: Window techniques – Rectangular, Hamming and Hanning window functions. Basic structures of FIR systems: Direct form, cascade form and linear form.		
Unit - III	**Infinite Impulse Response (IIR) Filters**	**9+3**
IIR filter design by Impulse Invariant method, IIR filter design by Bilinear transformation – Butterworth filters. Basic structures of IIR systems: Direct form I, Direct form II, Cascade form and Parallel form. **Effects of Finite Word Length in Digital Filters:** Quantization effects in analog to digital conversion of signals – Limit cycle oscillations.		
Unit - IV	**Multirate Digital Signal Processing**	**9+3**
Sampling rate conversion: Decimation, Interpolation, Sampling rate conversion by a rational factor M/L – Polyphase decomposition - Multistage decimators and interpolators		
Unit - V	**Applications of Digital Signal Processing**	**9+3**
Analysis on biomedical signals: ECG and EEG - Example of musical note separation using FFT in MATLAB - Signal smoothening using LPF in MATLAB - Noise removal using filters - Convolution using MATLAB - Subband coding of speech signals.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1	Salivahanan S.“Digital Signal Processing”, 3rdEdition, Tata McGraw Hill , New Delhi ,2013.

REFERENCES:

1	John G. Proakis & DimitrisG.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”. 3rdEdition, Pearson, New Delhi, 2014.
3.	Sanjith K.Mitra, “Digital Signal Processing: A Computer based Approach”, McGraw Hill Education 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the frequency response of LTI discrete system using Fourier transform	Applying (K3)
CO2	design and realize the FIR filters	Applying (K3)
CO3	design and realize the IIR filters	Applying (K3)
CO4	apply the concepts of multirate signal processing	Applying (K3)
CO5	analyze the applications of the signal processing concepts in the real world	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	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	3	2	2	2								3	3

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

ASSESSMENT PATTERN - THEORY

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

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.		

Lecture:45, Total:45

TEXT BOOK:

1	Frank D. Petruzella, " Programmable Logic Controllers", 5th Edition ,Tata McGraw Hill ,New Delhi ,**201**9.

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
(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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 continuous and discrete time systems
3.	Spectral analysis of signals using Fourier transform
4.	Design and analyze of FIR low pass filters using various techniques and realization of its structures
5.	Frequency response of continuous and discrete low pass IIR filter
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 continuous and discrete time signals and Systems	Applying(K3), Precision (S3)
CO2	design and implement filters	Analyzing (K4), 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

(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

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

(Note: Psychomotor domain for course outcomes of practical component: Imitation - S1, Manipulation – S2, Precision-S3, Articulation – S4, Naturalization – S5)

20EIP61 - PROJECT WORK 1 PHASE- 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)
CO5	Articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Characterization (A5) Articulation (S4)
CO6	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:90

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)**

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)		

Lecture:45, 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&EIE	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	EC	0	0	6	3

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)
CO5	Articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Characterization (A5) Articulation (S4)
CO6	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:180

20EIP81 - PROJECT WORK 2

Programme & Branch	B.E&EIE	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	EC	0	0	14	7

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)
CO5	Articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Characterization (A5) Articulation (S4)
CO6	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:270

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.		

Lecture:45, 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” 1st Edition, 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.		

Lecture:45, 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 PICmicrocontroller	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 Preposition – 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: Inverted Pendulum.		
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).		

Lecture:45,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.(5th unit)

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	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	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'.		

Lecture:45, 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. (Unit 1,2)

REFERENCES:

1	Moe Toghraei, "Piping and Instrumentation Diagram Development", 1st Edition, Wiley-Blackwell, USA, 2019. Unit (3,4,5)
2	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.		

Lecture:45, Total:45

TEXT BOOK:

1	Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", 4th Edition, Pearson Education, New Delhi, 2014 (Unit 1 to IV).
2	VedamSubrahmanyam,"Electric Drives-Concepts and Applications", 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2017 (Unit V).

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.		

Lecture:45, Total:45

TEXT BOOK:

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

Lecture:45, 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.		

Lecture: 45, 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 and KL 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, Noise Removal, Thinning, Thickening.		
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 – Face Recognition: Pixel-based Techniques		

Lecture:45, 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.		

Lecture:45, 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.		

Lecture:45, Total:45

TEXT BOOK:

1	John G. Webster, HalitEren, "Measurement, Instrumentation, and Sensors Handbook", 2nd Edition, 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.		

Lecture:45, Total:45

TEXT BOOK:

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

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)**

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 fibres and lasers. The course will provide students with adequate knowledge about industrial application of optical fibres and lasers, holography and medical applications of lasers.	
Unit - I	**Optical Fibres 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 Fibres**	**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.		

Lecture:45, Total:45

TEXT BOOK:

1	Thyagarajan K, AjoyGhatak, "Lasers: Fundamentals and Applications' 2nd Edition,Springer Science & Business Media, New York, 2011.
2	John.M. Senior, "Optical Fibre Communication – Principles and Practice", 3rd edition, Pearson Education India, New Delhi,2010.

REFERENCES:

1	John F. Ready, "Industrial Applications of Lasers", 2nd Edition, Academic Press, San Diego,1997.
2	David A. Krohn, Trevor W. MacDougall, &Alexis Mendez, "Fiber Optic Sensors: Fundamentals and Applications", 4th Edition, SPIE Press,Bellingham,2015.
3	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.		

Lecture:45, 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.		

Lecture:45, Total:45

TEXT BOOK:

1	Josh Patterson & Adam Gibson, “Deep Learning, A Practioner’s Approach”, 1st Edition, O’Reilley Media,Inc, USA, 2017.
2	Sridhar S., “Digital Image Processing”, Fourth Impression, Oxford University Press, New Delhi, 2013.

REFERENCES:

1	Ian Godfellow, YoshuaBengio, & 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	1								3	3
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								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		

Lecture:45, 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.		

Lecture:45, 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.		

Lecture: 45, Total:45

TEXT BOOK:

1	Kirk, Donald E. "Optimal Control Theory: An Introduction" 1st Edition, Dover publications, USA, 2004. (Unit-1,2 &3)
2	Karl J Astrom and Bjorn Wittenmark, " Adaptive Control", 2nd Edition, Addison Wesley, USA, 1995. (Unit-4&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.		

Lecture: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.		

Lecture:45, 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 – βn/βp 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).		

Lecture:45, Total:45

TEXT BOOK:

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

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.		

Lecture:45, Total:45

TEXT BOOK:

1	Tai-Ran Hsu, "MEMS and Microsystems: Design, Manufacture and Nano Scale Engineering", 2nd Edition, 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.		

Lecture:45, 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", 1stEdition, Aviation Supplies and Academics, Washington,2013.
2	Megson T M G., "Aircraft Structures for Engineering Students", 4thEdition, 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.		

Lecture:45, 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.(5th unit).
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.		

Lecture:45, 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.		

Lecture:45, Total:45

TEXT BOOK:

1	David L. hall, Sonya A.H. McMullen,"Mathematical techniques in Multisensor data fusion", 2nd Edition, Artech House, Boston, 2004.
2.	Martin E. liggins, David L. Hall and James Llinas, "Handbook of Multisensor Data Fusion: Theory and Practice" , 2nd Edition, CRC Press, Boca Raton2009.

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.		

Lecture:45, Total:45

TEXT BOOK:

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

REFERENCES:

1	David A Bell, Electronic Instrumentation and Measurements, Oxford University Press, New Delhi,2003. (Unit-5)
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		

Lecture:45, 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.		

Lecture:45, Total:45

TEXT BOOK:

1	Liptak B.G, "Instrumentation in the Processing Industries", 1st Edition, Chilton Book Company, Boston, 1973.(Digitized 2008)

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.
3.	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124105 (Unit-IV) Metal Detection - Dairy Knowledge Portal https://www.dairyknowledge.in › default › files(Unit-IV)

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.		

Lecture:45, 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 requiredto 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.		

Lecture:45, Total:45

TEXT BOOK:

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

Lecture:45, Total:45

TEXT BOOK:

1	Khandpur R.S., ”Handbook of Biomedical Instrumentation”, 2nd Edition, 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”, 2nd Edition, 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.		

Lecture:45, 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.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Hernando Ombao , Martin Lindquist , Wesley Thompson, John Aston ,"Handbook of Neuroimaging Data Analysis",1st Edition, Taylor & Francis group, 2017 (1-5 units)

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.		

Lecture:45,Total:45

TEXT BOOK:

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

Lecture:45, 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”, 2nd Edition, 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.		

Lecture:45, Total:45

TEXT BOOK:

1	Yugeng Xi,& Dewei Li, "Predictive Control: Fundamentals and Developments", 1st Edition, Wiley Publishers, USA, 2019. (Units 2, 3,4 &5)

REFERENCES:

1	Rossiter J.A., "A First Course in Predictive Control" 2nd Edition, CRC Press, USA,2018. (Unit 1)
2	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)**