KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI - 2018

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2018 - 2019 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)

Graduate of Electronics and Instrumentation Engineering programme 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 2018
(Revision: 4)

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 2018 – 2019 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
BTech	Chemical Engineering
	Information Technology
	Food Technology

3. ADMISSION REQUIREMENTS

3.1 First Semester Admission

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

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

(OR)

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

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

3.2 Lateral Entry Admission

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

(OR)

The candidates who hold a BSc degree (10+2+3 stream) with mathematics as one of the

subjects at the BSc level from a recognised University are eligible to apply for Lateral entry admission to the third semester of BE / BTech. Such candidates shall undergo two additional Engineering course(s) in the third and fourth semesters as prescribed by the College.

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

4. STRUCTURE OF PROGRAMMES

4.1 Categorisation of Courses

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

i. Humanities and Social Sciences (HS) including Management Courses

ii. Basic Science (BS) Courses

iii. Engineering Science (ES) Courses

iv. Professional Core (PC) Courses

v. Professional Elective (PE) Courses

vi. Open Elective (OE) Courses

vii. Employability Enhancement Courses (EC) like Project work, Professional Skills/Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship in Industry or elsewhere

viii. Audit Courses (AC)

ix. Mandatory Courses (MC)

4.2 Credit Assignment

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 programme shall vary from 168 to 173 as per the chosen programme of study.

4.3 Employability Enhancement Courses

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

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

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

(OR)

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training 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 and Viva

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

4.3.3 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 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 courses or dropping of already registered additional elective 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) and earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.

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

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1 The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Comprehensive Test and Viva, Project Work, 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:

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

7.2 Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, internships and 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 the continuous assessment shall be for 100 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidates' records maintained.

7.5.1 The apportionment of continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course.

Type	Max. Marks	Remarks
Assessment based on rubrics for each experiment	50	Absolute Mark System
Assessment Test	50	
Total	100	Rounded off to one decimal place

7.6 Project Work II / Project Work I 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/ Project Work I 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	Super visor	Review Committee (excluding Super visor)	Super visor	Review Committee (excluding Super visor)	Super visor	Ext. Exr.	Super visor	Exr.1	Exr.2
0	0	10	10	15	15	20	10	10	10

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

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

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

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

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

7.7 Project Work I 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	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee	Supervisor	Review Committee
0	0	10	10	15	15	20	10	20

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

7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 4^{th} semester vacation and during 5^{th} semester. Phase II training shall be conducted for minimum of 80 hours in 5^{th} semester vacation and during 6^{th} semester. The evaluation procedure shall be approved by the Principal.

7.9 Comprehensive Test and Viva

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

7.10 Entrepreneurships/ Start ups

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

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

7.11 Projects through Internships

Each candidate shall submit a 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 Universal Human Values

The course imparting the human values shall be taught for all candidates who have joined in various branches of all BE/BTech programmes. This course shall carry a maximum of 100 marks and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits by successfully completing this course. Two continuous assessment tests will be conducted and the average marks will be taken for the GPA and CGPA calculations.

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 and satisfy the attendance requirements.

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

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

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

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

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

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

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

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

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

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

11. PROVISION FOR BREAK OF STUDY

11.1 A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination.

A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

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

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

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

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

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

12. PASSING REQUIREMENTS

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

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

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

13. REVALUATION OF ANSWER SCRIPTS

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

14. SUPPLEMENTARY EXAMINATION

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

15. AWARD OF LETTER GRADES

Range of % of Total Marks	Letter Grade	Grade Point
91 to 100	O (Outstanding)	10
81 to 90	A+ (Excellent)	9
71 to 80	A (Very Good)	8
61 to 70	B+ (Good)	7
50 to 60	B (Average)	6
Less than 50	RA (Reappear)	0
Satisfactory	SF	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

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

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

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

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

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

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

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

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

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

16. ELIGIBILITY FOR THE AWARD OF DEGREE

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

i. Successfully completed all the courses under the different categories, as specified in the regulations.
ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).
iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2018 (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 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.

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.

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	**4**	**3**	**1**		**2**		**3**		**13**	**7.69**
BS	**11**	**11**	**4**	**4**					**30**	**17.75**
ES	**6**	**4**		**7**	**4**				**21**	**12.43**
PC		**3**	**19**	**11**	**13**	**12**			**58**	**34.32**
PE						**3**	**9**	**3**	**15**	**8.88**
OE					**4**	**4**	**3**	**3**	**14**	**8.28**
EC					**2**	**4**	**6**	**6**	**18**	**10.65**
Semester wise Total	**21**	**21**	**24**	**22**	**25**	**23**	**21**	**12**	**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.	18EGT11	English for Communication I	3	0	0	3	1
2.	18EGT21	English for Communication II	3	0	0	3	2
3.	18VEC11	Value Education	2	0	1	1	2
4.	18EGL31	English for Workplace Communication	0	0	2	1	4
5.	18GET51	Universal Human Values	2	0	0	2	5
6.	18MBT71	Engineering Economics and Management	3	0	0	3	7
Total Credits to be earned						**13**	

BASIC SCIENCE (BS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18MAC11	Mathematics I	3	1*	2*	4	1
2.	18PHC11	Applied Physics	3	0	2*	3.5	1
3.	18CYC11	Applied Chemistry	3	0	2*	3.5	1
4.	18MAC21	Mathematics II	3	1*	2*	4	2
5.	18PHC25	Materials Science and Opto Electronic Devices	3	0	2*	3.5	2
6.	18CYC25	Environmental Science and Organic Electronic Materials	3	0	2*	3.5	2
7.	18MAC31	Mathematics III	3	1*	2*	4	3
8.	18MAC41	Statistics and Numerical Methods	3	1*	2*	4	4
Total Credits to be earned						**30**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18GET11	Introduction to Engineering	3	0	0	3	1
2.	18CSC11	Problem Solving and Programming	2	0	2	3	1
3.	18MEC11	Engineering Drawing	2	0	2	3	2
4.	18MEL11	Engineering Practices Laboratory	0	0	2	1	2
5.	18MET46	Thermodynamics and Fluid Mechanics	3	0	0	3	4
6.	18CST45	Data Structures and Algorithms	3	0	0	3	4
7.	18CSL42	Data Structures and Algorithms Laboratory	0	0	2	1	4
8.	18EIT51	Control Systems	3	1	0	4	5
Total Credits to be earned						**21**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	18EIT21	Principles of Measuring Instruments	3	0	0	3	2	IN
2.	18EIT31	Transducers Engineering	3	0	0	3	3	IN
3.	18EIT32	Electrical Measurements and Instrumentation	3	0	0	3	3	IN
4.	18EIT33	Networks, Signals and Systems	3	1	0	4	3	EL
5.	18EIT34	Electron Devices and Circuits	3	0	0	3	3	EL
6.	18EIT35	Digital Logic Design	3	1	0	4	3	EL
7.	18EIL31	Devices and Circuits Laboratory	0	0	2	1	3	EL

8.	18EIL32	Transducers and Measurements Laboratory	0	0	2	1	3	IN
9.	18EIT41	Industrial Instrumentation-I	3	0	0	3	4	IN
10.	18EIT42	Analog Signal Conditioning in Instrumentation	3	0	0	3	4	EL
11.	18EIT43	DC and AC Machines	3	0	0	3	4	IN
12.	18EIL41	Instrumentation System Design Laboratory	0	0	2	1	4	IN
13.	18EIL42	Virtual Instrumentation Laboratory	0	0	2	1	4	IN
14.	18EIT52	Microprocessor and Microcontroller	3	0	0	3	5	EL
15.	18EIT53	Industrial Instrumentation – II	3	0	0	3	5	EL
16.	18EIT54	Digital Signal Processing	3	1	0	4	5	EL
17.	18EIL51	Electrical Machines and Control Laboratory	0	0	2	1	5	IN
18.	18EIL52	Microcontroller and Interfacing Laboratory	0	0	2	1	5	EL
19.	18EIL53	Industrial Instrumentation Laboratory	0	0	2	1	5	IN
20.	18EIT61	Process Control	3	0	0	3	6	IN
21.	18EIT62	Logic and Distributed Control Systems	3	0	0	3	6	IN
22.	18EIT63	Embedded Systems	3	0	0	3	6	EL
23.	18EIL61	Process Control Laboratory	0	0	2	1	6	IN
24.	18EIL62	Logic and Distributed Control Systems Laboratory	0	0	2	1	6	IN
25.	18EIL63	Signal Processing and Embedded Systems Laboratory	0	0	2	1	6	EL
Total Credits to be earned						**58**		

PROFESSIONAL ELECTIVE (PE)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
		Elective 1						
1.	18EIE01	Biomedical Instrumentation	3	0	0	3	6	AI
2.	18EIE02	VLSI Design	3	0	0	3	6	AE
3.	18EIE03	Soft Computing Techniques	3	0	0	3	6	EEA
4.	18EIE04	Piping and Instrumentation Diagrams	3	0	0	3	6	IA
5.	18EIE05	Industrial Electronics and Drives	3	0	0	3	6	CS
6.	18EIE06	Advanced Control Theory	3	0	0	3	6	CS
		Elective 2						
7.	18EIE07	Analytical Instrumentation	3	0	0	3	7	AI
8.	18EIE08	Electronic Instrumentation	3	0	0	3	7	AI

9.	18EIE09	Digital Image Processing	3	0	0	3	7	EEA
10.	18EIE10	Power Plant Instrumentation	3	0	0	3	7	IA
11.	18EIE11	Wireless Instrumentation	3	0	0	3	7	AE
12.	18EIE12	Advanced PID Control	3	0	0	3	7	CS
13.	18GEE01	Fundamentals of Research	3	0	0	3	7	GE
		Elective 3						
14.	18EIE13	Fiber Optics and Laser Instruments	3	0	0	3	7	AI
15.	18EIE14	Wearable Technology	3	0	0	3	7	AE
16.	18EIE15	Deep Neural Networks for Computational Imaging	3	0	0	3	7	EEA
17.	18EIE16	Instrumentation Techniques in Agriculture	3	0	0	3	7	IA
18.	18EIE17	Industrial Internet of Things	3	0	0	3	7	AE
19.	18EIE18	Optimal and Adaptive Control	3	0	0	3	7	CS
20.	18EIE31	Total Quality Management	3	0	0	3	7	GE
		Elective 4						
21.	18EIE19	Safety in Process Industries	3	0	0	3	7	AI
22.	18EIE20	MEMS and Nano Technology	3	0	0	3	7	AE
23.	18EIE21	Machine Learning and its Applications	3	0	0	3	7	EEA
24.	18EIE22	Instrumentation in Aircraft Navigation and Control	3	0	0	3	7	IA
25.	18EIE23	Industrial Data Communication	3	0	0	3	7	IA
26.	18EIE24	Computer Control of Processes	3	0	0	3	7	CS
		Elective 5						
27.	18MBE49	Entrepreneurship Development	3	0	0	3	8	GE
28.	18EIE25	Multi Sensor Data Fusion	3	0	0	3	8	EEA
29.	18EIE26	3D Printing Hardware	3	0	0	3	8	AE
30	18EIE27	Artificial Intelligence	3	0	0	3	8	EEA
31.	18EIE28	Instrumentation and Control in Process Industries	3	0	0	3	8	IA
32.	18EIE29	Intelligent Robotic Systems	3	0	0	3	8	AI
33.	18EIE30	Control System Components	3	0	0	3	8	CS
Total Credits to be earned						**15**		

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18GEL51/ 18GEI51	Professional Skills Training I / Industrial Training I	0	0	0	2	5
2.	18GEL61/ 18GEI61	Professional Skills Training II / Industrial Training II	0	0	0	2	6
3.	18GEP71	Comprehensive Test and Viva	0	0	0	2	7
4.	18EIP61	Project Work I Phase I	0	0	4	2	6
5.	18EIP71	Project Work I Phase II	0	0	8	4	7
6.	18EIP81	Project Work II / Internship	0	0	12	6	8
Total Credits to be earned						**18**	

Domain/Stream Abbreviations: GE – General Engineering, 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

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18EIO01	Neural Networks and Deep Learning	3	1	0	4	V
2.	18EIO02	Digital Image Processing and Its Applications	3	1	0	4	VI
3.	18EIO03	Industrial Automation	3	1	0	4	VI
4.	18EIO04	Biomedical Instrumentation and Applications	3	0	0	3	VII
5.	18EIO05	PLC Programming and Its Applications	3	0	0	3	VII
6.	18EIO06	Measurements and Instrumentation	3	0	0	3	VIII
7.	18EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)

S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**OFFERED BY**
		SEMESTER V					
8.	18MAO01	Mathematical Foundations of Machine Learning	3	1	0	4	MATHS
9.	18PHO01	Thin film Technology	3	1	0	4	PHYSICS
10.	18CYO01	Corrosion Science and Engineering	3	1	0	4	CHEMISTRY
11.	18CEO01	Remote Sensing and its Applications	3	0	2	4	CIVIL
12.	18MEO01	Renewable Energy Sources	3	0	2	4	MECH
13.	18MTO01	Design of Mechatronics Systems	3	1	0	4	MTS

14.	18AUO01	Automotive Engineering	3	0	2	4	AUTO
15.	18ECO01	PCB Design and Fabrication	3	0	2	4	ECE
16.	18ECO02	Neural Networks and Fuzzy Logic for Engineering Applications	3	0	2	4	ECE
17.	18EEO01	Electrical Wiring and Lighting	3	1	0	4	EEE
18.	18EEO02	Solar and Wind Energy Systems	3	1	0	4	EEE
19.	18CSO01	Data Structures and its Applications	3	0	2	4	CSE
20.	18CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE
21.	18CSO03	Computational Science for Engineers	3	1	0	4	CSE
22.	18ITO01	Python Programming	3	0	2	4	IT
23.	18ITO02	Advanced Java Programming	3	0	2	4	IT
24.	18CHO01	Polymer Technology	3	1	0	4	CHEM
25.	18CHO02	Introduction to Drugs and Pharmaceuticals Technology	3	1	0	4	CHEM
26.	18FTO01	Food Processing Technology	3	1	0	4	FT
27.	18FTO02	Baking Technology	3	0	2	4	FT
		SEMESTER VI					
28.	18MAO02	Graph Theory and its Applications	3	1	0	4	MATHS
29.	18MAO03	Number Theory and Cryptography	3	1	0	4	MATHS
30.	18CYO02	Instrumental Methods of Analysis	3	1	0	4	CHEMISTRY
31.	18CEO02	Disaster Management	3	1	0	4	CIVIL
32.	18MEO02	Design of Experiments	3	0	2	4	MECH
33.	18MTO02	Factory Automation	3	0	2	4	MTS
34.	18MTO03	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
35.	18AUO02	Autonomous Vehicles	3	1	0	4	AUTO
36.	18ECO03	Principles of Quantum Computing	3	0	2	4	ECE
37.	18EEO03	Energy Conservation and Management	3	1	0	4	EEE
38.	18CSO04	Web Engineering	3	0	2	4	CSE
39.	18CSO05	Foundations of Data Analytics	3	1	0	4	CSE
40.	18CSO06	Nature Inspired Optimization Techniques	3	1	0	4	CSE
41.	18CSO07	Introducing Data Science	3	1	0	4	CSE
42.	18ITO03	Java Programming	3	1	0	4	IT
43.	18ITO04	Next Generation Databases	3	1	0	4	IT
44.	18CHO03	Bio Energy Resources	3	1	0	4	CHEM

45.	18CHO04	Fundamentals of Nanoscience and Nanotechnology	3	1	0	4	CHEM
46.	18FTO03	Processing of Milk and Milk Products	3	0	2	4	FT
47.	18FTO04	Processing of Fruits and Vegetables	3	0	2	4	FT
		SEMESTER VII					
48.	18MAO04	Advanced Linear Algebra	3	0	0	3	MATHS
49.	18MAO05	Optimization Techniques	3	0	0	3	MATHS
50.	18PHO02	Structural and Optical Characterization of Materials	3	0	0	3	PHYSICS
51.	18CYO03	Waste and Hazardous Waste Management	3	0	0	3	CHEMISTRY
52.	18CEO03	Introduction to Smart Cities	3	0	0	3	CIVIL
53.	18CEO04	Environmental Health and Safety	3	0	0	3	CIVIL
54.	18MEO03	Fundamentals of Ergonomics	3	0	0	3	MECH
55.	18MEO04	Principles of Management and Industrial Psychology	3	0	0	3	MECH
56.	18MTO04	3D Printing and Design	3	0	0	3	MTS
57.	18MTO05	Drone System Technology	3	0	0	3	MTS
58.	18AUO03	Alternate Fuels for Automobile	3	0	0	3	AUTO
59.	18ECO04	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
60.	18ECO05	Principles of Communication Techniques	3	0	0	3	ECE
61.	18EEO04	Micro Grid and Smart Grid	3	0	0	3	EEE
62.	18EEO05	Electrical Safety	3	0	0	3	EEE
63.	18CSO08	Artificial Intelligence and its Applications	3	0	0	3	CSE
64.	18ITO05	Business Continuity Planning	3	0	0	3	IT
65.	18ITO06	Mobile Application Development	3	0	0	3	IT
66.	18CHO05	Enzyme Engineering	3	0	0	3	CHEM
67.	18CHO06	Nuclear Engineering	3	0	0	3	CHEM
68.	18FTO05	Principles of Food safety	3	0	0	3	FT
69.	18FTO06	Food and Nutrition	3	0	0	3	FT
		SEMESTER VIII					
70.	18CEO05	Infrastructure Planning and Management	3	0	0	3	CIVIL
71.	18CEO06	Environmental Laws and Policy	3	0	0	3	CIVIL
72.	18MEO05	Safety Measures for Engineers	3	0	0	3	MECH
73.	18MEO06	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
74.	18MTO06	Robotics	3	0	0	3	MTS

75.	18MTO07	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS
76.	18AUO04	Automotive Electronics	3	0	0	3	AUTO
77.	18AUO05	Vehicle Maintenance	3	0	0	3	AUTO
78.	18ECO06	Bioinspired Computing Technologies	2	0	2	3	ECE
79.	18EEO06	Electric Vehicle	3	0	0	3	EEE
80.	18CSO09	Applied Machine Learning	3	0	0	3	CSE
81.	18CSO10	Fundamentals of Blockchain	3	0	0	3	CSE
82.	18CSO11	Fundamentals of Internet of Things	3	0	0	3	CSE
83.	18ITO07	Essentials of Information Technology	3	0	0	3	IT
84.	18ITO08	Virtual and Augmented Reality Frameworks	3	0	0	3	IT
85.	18CHO07	Fertilizer Technology	3	0	0	3	CHEM
86.	18FTO07	Food Ingredients	3	0	0	3	FT
87.	18FTO08	Fundamentals of Food Packaging and Storage	3	0	0	3	FT

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

S. No.	Course Code	Course Title	L	T	P	C	Offering Department	Semester
88.	18GEO01	German Language Level 1	4	0	0	4	ECE	V/ VI/ VII/ VIII
89.	18GEO02	Japanese Language Level 1	4	0	0	4	ECE	V/ VI/ VII/ VIII
90.	18GEO03	Design Thinking for Engineers	3	0	0	3	CSE	VI
91.	18GEO04	Innovation and Business Model Development	3	0	0	3	MTS	VIII
92.	18GEO05	German Language Level 2	4	0	0	4	ECE	V/ VI/ VII/ VIII
93.	18GEO06	German Language Level 3	3	0	0	3	ECE	V/ VI/ VII/ VIII
94.	18GEO07	German Language Level 4	3	0	0	3	ECE	V/ VI/ VII/ VIII
95.	18GEO08	Japanese Language Level 2	4	0	0	4	ECE	V/ VI/ VII / VIII
96.	18GEO09	Japanese Language Level 3	3	0	0	3	ECE	V/ VI/ VII / VIII
97.	18GEO10	Japanese Language Level 4	3	0	0	3	ECE	V/ VI/ VII / VIII
98.	18GEO11	NCC Studies (Army Wing) – I	3	0	2	4	EEE	V/ VI
99.	18GEO12	NCC Studies (Air Wing) – I	3	0	2	4	IT	V / VI

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

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	18EGT11 English forCommuni-cation I (3-0-0-3)	18MAC11 Mathematics I (3-1*-2*-4)	18PHC11 Applied Physics (3-0-2*-3.5)	18CYC11 Applied Chemistry (3-0-2*-3.5)	18GET11 Introduction to Engineering (3-0-0-3)	18CSC11 Problem Solving and Programming (2-0-2-3)	18VEC11 Value Education (0-0-2-1)				**21**
II	18EGT21 English for Communi-cation II (3-0-0-3)	18MAC21 Mathematics II (3-1*-2*-4)	18PHC25 Materials Science and OptoElectronic Devices (3-0-2*-3.5)	18CYC24 Environmental Science and Fuel Cells (3-0-2*-3.5)	18MEC11 Engineering Drawing (2-0-2-3)	18EIT21 Principles of Measuring Instruments (3-0-0-3)	18MEL11 Engineering Practices Laboratory (0-0-2-1))				**21**
III	18MAC31 Mathematics III (3-1*-2*-4)	18EIT31 Transducers Engineering (3-0-0-3)	18EIT32 Electrical Measurements and instrumenta tion (3-0-0-3)	18EIT33 Networks, Signals and Systems (3-1-0-4)	18EIT34 Electron Devices and Circuits (3-0-0-3)	18EIT35 Digital Logic Design (3-1-0-4)	18EIL31 Devices and Circuits Laboratory (0-0-2-1)	18EIL32 Transducers and Measure ments Laboratory (0-0-2-1)	18EGL31 English for Work Place Communi cation (0-0-2-1)		**24**
IV	18MAC41 Statistics and Numerical Methods (3-1*--2*-4)	18MET46 Thermo dynamics and Fluid Mechanics (3-0-0-3)	18CST45 Data Structures and Algorithms (3-0-0-3)	18EIT41 Industrial Instrumenta tion-I (3-0-0-3)	18EIT42 Analog Signal Conditioning in Instrumen tation (3-0-0-3)	18EIT43 DC and AC Machines (3-0-0-3)	18CSL42 Data Structures and Algorithms Laboratory (0-0-2-1)	18EIL41 Instrumen tation System Design Laboratory (0-0-2-1)	18EIL42 Virtual Instrumen tation Laboratory (0-0-2-1)		**22**
V	18EIT51 Control Systems (3-1-0-4)	18EIT52 Micro processor and Micro controller (3-0-0-3)	18EIT53 Industrial Instrumen tation – II (3-0-0-3)	18EIT54 Digital Signal Processing (3-1-0-4)	Open Elective I (3-1/0-2/0-4)	18EIL51 Electrical Machines and Control Laboratory (0-0-2-1)	18EIL52 Micro controller and Interfacing Laboratory (0-0-2-1)	18EIL53 Industrial Instrumen tation Laboratory (0-0-2-1)	18GEL51/ 18GEI51 Professional Skills Training I / Industrial Training I (0-0-0-2)	18GET51 Universal Human Values (2-0-0-2)	**25**
VI	18EIT61 Process Control (3-0-0-3)	18EIT62 Logic and Distributed Control Systems (3-0-0-3)	18EIT63 Embedded Systems (3-0-0-3)	Professional Elective I (3-0-0-3)	Open Elective II (3-1/0-0/2-4)	18EIL61 Process Control Laboratory (0-0-2-1)	18EIL62 Logic and Distributed Control Systems Laboratory (0-0-2-1)	18EIL63 Signal Processing and Embedded Systems Laboratory (0-0-2-1)	18GEL61/ 18GEI61 Professional Skills Training II / Industrial Training II (0-0-0-2)	18EIP61 Project Work I Phase I (0-0-4-2)	**23**
VII	18MBT71 Engineering Economics and Management (3-0-0-3)	Open Elective III (3-0-0-3)	Professional Elective II (3-0-0-3)	Professional Elective III (3-0-0-3)	Professional Elective IV (3-0-0-3)	18GEP71 Comprehen-sive Test / Viva (0-0-0-2)	18EIP71 Project Work I Phase II (0-0-8-4)				**21**
VIII	Open Elective IV (3-0-0-3)	Professional Elective V (3-0-0-3)	18EIP81 Project Work II / Internship (0-0-12-6)								**12**

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	18EGT11	English for Communication I						✓			✓	✓	✓	✓		
1	18MAC11	Mathematics I	✓	✓	✓	✓	✓									
1	18PHC11	Applied Physics	✓	✓	✓	✓										
1	18CYC11	Applied Chemistry	✓	✓	✓	✓										
1	18GET11	Introduction to Engineering	✓	✓	✓	✓		✓	✓					✓		
1	18CSC11	Problem Solving and Programming	✓	✓	✓	✓	✓					✓				
1	18VEC11	Value Education						✓		✓				✓		
2	18EGT21	English for Communication II						✓			✓	✓	✓	✓		
2	18MAC21	Mathematics II	✓	✓	✓		✓									
2	18PHC25	Materials Science and Opto Electronic Devices	✓	✓	✓	✓										
2	18CYC24	Environmental Science And Fuel Cells	✓	✓	✓	✓			✓							
2	18MEC11	Engineering Drawing	✓	✓	✓	✓					✓	✓	✓	✓		
2	18EIT21	Principles of Measuring Instruments	✓	✓	✓	✓	✓								✓	✓
2	18MEL11	Engineering Practices Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	✓		
3	18MAC31	Mathematics III	✓	✓	✓	✓	✓								✓	✓
3	18EIT31	Transducers Engineering	✓	✓	✓	✓	✓								✓	✓
3	18EIT32	Electrical Measurements and Instrumentation	✓	✓	✓	✓	✓								✓	✓
3	18EIT33	Networks, Signals and Systems	✓	✓	✓	✓	✓								✓	✓
3	18EIT34	Electron Devices and Circuits	✓	✓	✓	✓	✓								✓	✓
3	18EIT35	Digital Logic Design	✓	✓	✓	✓	✓								✓	✓
3	18EIL31	Devices and Circuits Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	18EIL32	Transducers and Measurements Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	18EGL31	English For Workplace Communication									✓	✓		✓		
4	18MAC41	Statistics and Numerical Methods	✓	✓	✓	✓	✓								✓	✓
4	18MET46	Thermodynamics and Fluid Mechanics	✓	✓	✓		✓		✓						✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
4	18CST45	Data Structures and Algorithms	✓	✓	✓	✓	✓								✓	✓
4	18EIT41	Industrial Instrumentation-I	✓	✓	✓	✓	✓								✓	✓
4	18EIT42	Analog Signal Conditioning in Instrumentation	✓	✓	✓	✓	✓								✓	✓
4	18EIT43	DC and AC Machines	✓	✓	✓	✓	✓								✓	✓
4	18CSL42	Data Structures and Algorithms Laboratory	✓	✓	✓	✓									✓	✓
4	18EIL41	Instrumentation System Design Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
4	18EIL42	Virtual Instrumentation Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	18EIT51	Control Systems	✓	✓	✓										✓	✓
5	18EIT52	Microprocessor and Microcontroller	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
5	18EIT53	Industrial Instrumentation – II	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
5	18EIT54	Digital Signal Processing	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
5	18EIL51	Electrical Machines and Control Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	18EIL52	Microcontroller and Interfacing Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	18EIL53	Industrial Instrumentation Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	18GEL51/ 18GEI51	Professional Skills Training 1 / Industrial Training 1	✓	✓				✓	✓		✓	✓	✓	✓	✓	✓
5	18GET51	Universal Human Values						✓		✓						
6	18EIT61	Process Control	✓	✓	✓	✓	✓			✓				✓	✓	✓
6	18EIT62	Logic and Distributed Control Systems	✓	✓	✓	✓	✓			✓		✓			✓	✓
6	18EIT63	Embedded Systems	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
6	18EIL61	Process Control Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	18EIL62	Logic and Distributed Control Systems Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	18EIL63	Signal Processing and Embedded Systems Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	18GEL61/ 18GEI61	Professional Skills Training II /Industrial Training II	✓	✓				✓	✓		✓	✓	✓	✓	✓	✓
6	18EIP61	Project Work I Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	18MBT71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	18GEP71	Comprehensive Test and Viva	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
7	18EIP71	Project Work I Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	18EIP71	Project Work II/ Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Courses														
6	18EIE01	Biomedical Instrumentation	✓	✓	✓	✓	✓	✓		✓					✓	✓
6	18EIE02	VLSI Design	✓	✓	✓	✓	✓					✓			✓	✓
6	18EIE03	Soft Computing Techniques	✓	✓	✓	✓	✓								✓	✓
6	18EIE04	Piping and Instrumentation Diagrams	✓	✓	✓	✓	✓			✓		✓			✓	✓
6	18EIE05	Industrial Electronics and Drives	✓	✓	✓	✓	✓								✓	✓
6	18EIE06	Advanced Control theory	✓	✓	✓	✓	✓					✓			✓	✓
7	18EIE07	Analytical Instrumentation	✓	✓	✓	✓	✓	✓							✓	✓
7	18EIE08	Electronic Instrumentation	✓	✓	✓	✓	✓			✓					✓	✓
7	18EIE09	Digital Image Processing	✓	✓	✓	✓	✓			✓		✓			✓	✓
7	18EIE10	Power Plant Instrumentation	✓	✓	✓	✓	✓		✓			✓			✓	✓
7	18EIE11	Wireless Instrumentation	✓	✓				✓		✓					✓	✓
7	18EIE12	Advanced PID Control	✓	✓	✓	✓	✓			✓		✓			✓	✓
7	18GEE01	Fundamentals of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	18EIE13	Fiber Optics and Laser Instruments	✓	✓	✓	✓	✓								✓	✓
7	18EIE14	Wearable Technology	✓	✓	✓	✓	✓	✓							✓	✓
7	18EIE15	Deep Neural Networks for Computational Imaging	✓	✓	✓	✓	✓								✓	✓
7	18EIE16	Instrumentation Techniques in Agriculture	✓	✓											✓	✓
7	18EIE17	Industrial Internet of Things	✓	✓	✓	✓	✓								✓	✓
7	18EIE18	Optimal and Adaptive Control	✓	✓	✓	✓	✓								✓	✓
7	18EIE19	Safety in Process Industries	✓	✓	✓	✓	✓	✓		✓					✓	✓
7	18EIE20	MEMS and Nano Technology	✓	✓	✓	✓	✓								✓	✓
7	18EIE21	Machine Learning and its Applications	✓	✓	✓	✓	✓								✓	✓
7	18EIE22	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓								✓	✓
7	18EIE23	Industrial Data Communication	✓	✓	✓	✓	✓	✓		✓					✓	✓
7	18EIE24	Computer Control of Processes	✓	✓	✓	✓	✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	18MBE49	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
8	18EIE25	Multi Sensor Data Fusion	✓	✓	✓	✓	✓								✓	✓
8	18EIE26	3D Printing Hardware	✓	✓											✓	✓
8	18EIE27	Artificial Intelligence	✓	✓	✓	✓	✓								✓	✓
8	18EIE28	Instrumentation and Control in Process Industries	✓	✓	✓	✓	✓								✓	✓
8	18EIE29	Intelligent Robotic Systems	✓	✓	✓	✓	✓								✓	✓
8	18EIE30	Control System Components	✓	✓	✓	✓	✓					✓			✓	✓

		Open Elective Courses														
5	18MAO01	Mathematical Foundations of Machine Learning	✓	✓	✓	✓	✓									
5	18PHO01	Thin film Technology	✓	✓	✓											
5	18CYO01	Corrosion Science and Engineering	✓	✓	✓	✓										
5	18CEO01	Remote Sensing and its Applications	✓	✓	✓	✓	✓									
5	18MEO01	Renewable Energy Sources	✓	✓	✓	✓			✓			✓		✓		
5	18MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
5	18AUO01	Automotive Engineering	✓	✓	✓		✓									
5	18ECO01	PCB Design and Fabrication	✓	✓	✓	✓	✓				✓					
5	18ECO02	Neural Networks and Fuzzy Logic for Engineering Applications	✓	✓	✓	✓	✓				✓					
5	18EEO01	Electrical Wiring and Lighting	✓	✓	✓	✓	✓	✓								
5	18EEO02	Solar and Wind Energy Systems	✓	✓	✓	✓										
5	18CSO01	Data Structures and its Applications	✓	✓	✓	✓	✓									
5	18CSO02	Formal Languages and Automata Theory	✓	✓	✓	✓										
5	18CSO03	Computational Science for Engineers	✓	✓	✓	✓	✓									
5	18ITO01	Python Programming			✓		✓									
5	18ITO02	Advanced Java Programming			✓		✓									
5	18CHO01	Polymer Technology	✓	✓												

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	18CHO02	Introduction to Drugs and Pharmaceuticals Technology	✓	✓	✓	✓	✓									
5	18FTO01	Food Processing Technology	✓	✓	✓	✓										
5	18FTO02	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
6	18MAO02	Graph Theory and its Applications	✓	✓	✓											
6	18MAO03	Number Theory and Cryptography	✓	✓	✓		✓									
6	18CYO02	Instrumental Methods of Analysis	✓	✓	✓	✓										
6	18CEO02	Disaster Management	✓	✓	✓			✓	✓					✓		
6	18MEO02	Design of Experiments	✓	✓	✓	✓	✓						✓	✓		
6	18MTO02	Factory Automation	✓	✓	✓	✓	✓	✓			✓	✓		✓		
6	18MTO03	Data Acquisition and Virtual Instrumentation	✓	✓	✓	✓	✓				✓	✓		✓		
6	18AUO02	Autonomous Vehicles	✓	✓	✓											
6	18ECO03	Principles of Quantum Computing	✓	✓	✓	✓	✓									
6	18EEO03	Energy Conservation and Management	✓	✓	✓		✓									
6	18CSO04	Web Engineering	✓	✓	✓	✓										
6	18CSO05	Foundations of Data Analytics	✓	✓	✓											
6	18CSO06	Nature Inspired Optimization Techniques	✓	✓	✓	✓										
6	18CSO07	Introducing Data Science	✓	✓	✓											
6	18ITO03	Java Programming	✓	✓	✓	✓	✓	✓						✓		
6	18ITO04	Next Generation Databases	✓	✓	✓	✓										
6	18CHO03	Bio Energy Resources	✓	✓	✓	✓	✓									
6	18CHO04	Fundamentals of Nanoscience and Nanotechnology	✓	✓	✓	✓	✓									
6	18FTO03	Processing of Milk and Milk Products	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	18FTO04	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
7	18MAO04	Advanced Linear Algebra	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	18MAO05	Optimization Techniques	✓	✓	✓											
7	18PHO02	Structural and Optical Characterization of Materials	✓	✓	✓											
7	18CYO03	Waste and Hazardous Waste Management	✓	✓	✓	✓			✓							
7	18CEO03	Introduction to Smart Cities	✓	✓	✓				✓							
7	18CEO04	Environmental Health and Safety	✓	✓	✓	✓										
7	18MEO03	Fundamentals of Ergonomics	✓	✓	✓	✓		✓	✓			✓		✓		
7	18MEO04	Principles of Management and Industrial Psychology			✓			✓	✓	✓	✓	✓				
7	18MTO04	3D Printing and Design	✓	✓	✓	✓	✓						✓	✓		
7	18MTO05	Drone System Technology	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		
7	18AUO03	Alternate Fuels for Automobile	✓	✓												
7	18ECO04	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓								
7	18ECO05	Principles of Communication Techniques	✓	✓	✓	✓	✓									
7	18EEO04	Micro Grid and Smart Grid	✓	✓	✓	✓	✓									
7	18EEO05	Electrical Safety	✓	✓	✓											
7	18CSO08	Artificial Intelligence and its Applications	✓	✓	✓											
7	18ITO05	Business Continuity Planning	✓	✓	✓	✓										
7	18ITO06	Mobile Application Development	✓	✓	✓	✓										
7	18CHO05	Enzyme Engineering	✓	✓	✓	✓	✓									
7	18CHO06	Nuclear Engineering	✓	✓												
7	18FTO05	Principles of Food Safety	✓	✓	✓		✓	✓	✓	✓				✓		
7	18FTO06	Food and Nutrition	✓	✓	✓	✓								✓		
7	18CEO05	Infrastructure Planning and Management	✓	✓	✓											
8	18CEO06	Environmental Laws and Policy	✓	✓	✓	✓										
8	18MEO05	Safety Measures for Engineers		✓		✓	✓	✓	✓	✓	✓			✓		
8	18MEO06	Energy Conservation in Thermal Equipments	✓	✓	✓			✓	✓			✓	✓	✓		
8	18MTO06	Robotics	✓	✓	✓	✓	✓							✓		
8	18MTO07	Virtual and Augment Reality in Industry 4.0	✓	✓	✓	✓	✓	✓						✓		
8	18AUO04	Automotive Electronics	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	18AUO05	Vehicle Maintenance	✓		✓			✓								
8	18ECO06	Bioinspired Computing Technologies	✓	✓	✓	✓										
8	18EEO06	Electric Vehicle	✓	✓	✓	✓	✓									
8	18CSO09	Applied Machine Learning	✓	✓	✓											
8	18CSO10	Fundamentals of Blockchain	✓	✓	✓	✓										
8	18CSO11	Fundamentals of Internet of Things	✓	✓	✓	✓	✓									
8	18ITO07	Essentials of Information Technology	✓	✓	✓	✓										
8	18ITO08	Virtual and Augmented Reality Frameworks	✓	✓	✓	✓										
8	18CHO07	Fertilizer Technology	✓	✓												
8	18FTO07	Food Ingredients	✓	✓	✓			✓						✓		
8	18FTO08	Fundamentals of Food Packaging and Storage	✓	✓	✓		✓	✓		✓				✓		
		General Open Elective														
5,6,7,8	18GEO01	German Language Level 1								✓	✓	✓		✓		
5,6,7,8	18GEO02	Japanese Language Level 1								✓	✓	✓		✓		
7	18GEO03	Design Thinking for Engineers	✓	✓	✓	✓										
8	18GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5,6,7,8	18GEO05	German Language Level 2								✓	✓	✓		✓		
5,6,7,8	18GEO06	German Language Level 3								✓	✓	✓		✓		
5,6,7,8	18GEO07	German Language Level 4								✓	✓	✓		✓		
5,6,7,8	18GEO08	Japanese Language Level 2								✓	✓	✓		✓		
5,6,7,8	18GEO09	Japanese Language Level 3								✓	✓	✓		✓		
5,6,7,8	18GEO10	Japanese Language Level 4								✓	✓	✓		✓		
5,6	18GEO11	NCC Studies (Army Wing) – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5,6	18GEO12	NCC Studies (Air Wing) – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2018

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18EGT11	English for Communication I	3	0	0	3	50	50	100	HS
18MAC11	Mathematics I	3	1*	2*	4	50	50	100	BS
18PHC11	Applied Physics	3	0	2*	3.5	50	50	100	BS
18CYC11	Applied Chemistry	3	0	2*	3.5	50	50	100	BS
18GET11	Introduction to Engineering	3	0	0	3	50	50	100	ES
18CSC11	Problem Solving and Programming	2	0	2	3	50	50	100	ES
Practical / Employability Enhancement									
18VEC11	Value Education	2	0	1	1	50	50	100	HS
Total Credits to be earned					**21**				

***Alternate Weeks**

SEMESTER – II									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18EGT21	English for Communication II	3	0	0	3	50	50	100	HS
18MAC21	Mathematics II	3	1*	2*	4	50	50	100	BS
18PHC25	Materials Science and Opto Electronic Devices	3	0	2*	3.5	50	50	100	BS
18CYC24	Environmental Science and Fuel Cells	3	0	2*	3.5	50	50	100	BS
18MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
18EIT21	Principles of Measuring Instruments	3	0	0	3	50	50	100	PC
Practical / Employability Enhancement									
18MEL11	Engineering Practices Laboratory	0	0	2	1	100	0	100	ES
Total Credits to be earned					**21**				

***Alternate Weeks**

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2018

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18MAC31	Mathematics III	3	1	0	4	50	50	100	BS
18EIT31	Transducers Engineering	3	0	0	3	50	50	100	PC
18EIT32	Electrical Measurements and Instrumentation	3	0	0	3	50	50	100	PC
18EIT33	Networks, Signals and Systems	3	1	0	4	50	50	100	PC
18EIT34	Electron Devices and Circuits	3	0	0	3	50	50	100	PC
18EIT35	Digital Logic Design	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
18EIL31	Devices and Circuits Laboratory	0	0	2	1	100	0	100	PC
18EIL32	Transducers and Measurements Laboratory	0	0	2	1	100	0	100	PC
18EGL31	English for Workplace Communication	0	0	2	1	100	0	100	HS
Total Credits to be earned					**24**				

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18MAC41	Statistics and Numerical Methods	3	1*	2*	4	50	50	100	BS
18MET46	Thermodynamics and Fluid Mechanics	3	0	0	3	50	50	100	ES
18CST45	Data Structures and Algorithms	3	0	0	3	50	50	100	ES
18EIT41	Industrial Instrumentation I	3	0	0	3	50	50	100	PC
18EIT42	Analog Signal Conditioning in Instrumentation	3	0	0	3	50	50	100	PC
18EIT43	DC and AC Machines	3	0	0	3	50	50	100	PC
Practical / Employability Enhancement									
18CSL42	Data Structures and Algorithms Laboratory	0	0	2	1	100	0	100	ES
18EIL41	Instrumentation System Design Laboratory	0	0	2	1	100	0	100	PC
18EIL42	Virtual Instrumentation Laboratory	0	0	2	1	100	0	100	PC
Total Credits to be earned					**22**				

***Alternate Weeks**

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2018

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18EIT51	Control Systems	3	1	0	4	50	50	100	ES
18EIT52	Microprocessor and Microcontroller	3	0	0	3	50	50	100	PC
18EIT53	Industrial Instrumentation II	3	0	0	3	50	50	100	PC
18EIT54	Digital Signal Processing	3	1	0	4	50	50	100	PC
	Open Elective I	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
18EIL51	Electrical Machines and Control Laboratory	0	0	2	1	100	0	100	PC
18EIL52	Microcontroller and Interfacing Laboratory	0	0	2	1	100	0	100	PC
18EIL53	Industrial Instrumentation Laboratory	0	0	2	1	100	0	100	PC
18GEL51/ 18GEI51	Professional Skills Training I / Industrial Training I *	--	--	--	2	100	0	100	EC
18GET51	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**25**				

***80 Hours of Training**

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18EIT61	Process Control	3	0	0	3	50	50	100	PC
18EIT62	Logic and Distributed Control Systems	3	0	0	3	50	50	100	PC
18EIT63	Embedded Systems	3	0	0	3	50	50	100	PC
	Professional Elective I	3	0	0	3	50	50	100	PE
	Open Elective II	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
18EIL61	Process Control Laboratory	0	0	2	1	100	0	100	PC
18EIL62	Logic and Distributed Control Systems Laboratory	0	0	2	1	100	0	100	PC
18EIL63	Signal Processing and Embedded Systems Laboratory	0	0	2	1	100	0	100	PC
18GEL61/ 18GEI61	Professional Skills Training II / Industrial Training II *	---	---	---	2	100	0	100	EC
18EIP61	Project Work I Phase I	0	0	4	2	100	0	100	EC
Total Credits to be earned					**23**				

***80 Hours of Training**

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2018

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18MBT71	Engineering Economics and Management	3	0	0	3	50	50	100	HS
	Professional Elective II	3	0	0	3	50	50	100	PE
	Professional Elective III	3	0	0	3	50	50	100	PE
	Professional Elective IV	3	0	0	3	50	50	100	PE
	Open Elective III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
18GEP71	Comprehensive Test and Viva	---	---	---	2	100	0	100	EC
18EIP71	Project Work I Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					**21**				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
	Professional Elective V	3	0	0	3	50	50	100	PE
	Open Elective IV	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
18EIP81	Project Work II / Internship	---	---	12	6	50	50	100	EC
Total Credits to be earned					**12**				

Total Credits: 169

LIST OF PROFESSIONAL ELECTIVE COURSES (PE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
		Semester VI					
		Elective I					
1.	18EIE01	Biomedical Instrumentation	3	0	0	3	AI
2.	18EIE02	VLSI Design	3	0	0	3	AE
3.	18EIE03	Soft Computing Techniques	3	0	0	3	EEA
4.	18EIE04	Piping and Instrumentation Diagrams	3	0	0	3	IA
5.	18EIE05	Industrial Electronics and Drives	3	0	0	3	CS
6.	18EIE06	Advanced Control Theory	3	0	0	3	CS
		Semester VII					
		Elective II					
7.	18EIE07	Analytical Instrumentation	3	0	0	3	AI
8.	18EIE08	Electronic Instrumentation	3	0	0	3	AI
9.	18EIE09	Digital Image Processing	3	0	0	3	EEA
10.	18EIE10	Power Plant Instrumentation	3	0	0	3	IA
11.	18EIE11	Wireless Instrumentation	3	0	0	3	AE
12.	18EIE12	Advanced PID Control	3	0	0	3	CS
13.	18GEE01	Fundamentals of Research	3	0	0	3	GE
		Elective III					
14.	18EIE13	Fiber Optics and Laser Instruments	3	0	0	3	AI
15.	18EIE14	Wearable Technology	3	0	0	3	AE
16.	18EIE15	Deep Neural Networks for Computational Imaging	3	0	0	3	EEA
17.	18EIE16	Instrumentation Techniques in Agriculture	3	0	0	3	IA
18.	18EIE17	Industrial Internet of Things	3	0	0	3	AE
19.	18EIE18	Optimal and Adaptive Control	3	0	0	3	CS
20.	18EIE31	Total Quality Management	3	0	0	3	GE
		Elective IV					
21.	18EIE19	Safety in Process Industries	3	0	0	3	AI
22.	18EIE20	MEMS and Nano Technology	3	0	0	3	AE
23.	18EIE21	Machine Learning and its Applications	3	0	0	3	EEA

24.	18EIE22	Instrumentation in Aircraft Navigation and Control	3	0	0	3	IA
25.	18EIE23	Industrial Data Communication	3	0	0	3	IA
26.	18EIE24	Computer Control of Processes	3	0	0	3	CS
		Semester VIII					
		Elective V					
27.	18MBE49	Entrepreneurship Development	3	0	0	3	GE
28.	18EIE25	Multi Sensor Data Fusion	3	0	0	3	EEA
29	18EIE26	3D Printing Hardware	3	0	0	3	AE
30.	18EIE27	Artificial Intelligence	3	0	0	3	EEA
31.	18EIE28	Instrumentation and Control in Process Industries	3	0	0	3	IA
32.	18EIE29	Intelligent Robotic Systems	3	0	0	3	AI
33.	18EIE30	Control System Components	3	0	0	3	CS

Domain/Stream Abbreviations: GE – General Engineering, 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

LIST OF OPEN ELECTIVE COURSES (OE) OFFERED TO OTHER DEPARTMENTS							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18EIO01	Neural Networks and Deep Learning	3	1	0	4	V
2.	18EIO02	Digital Image Processing and Its Applications	3	1	0	4	VI
3.	18EIO03	Industrial Automation	3	1	0	4	VI
4.	18EIO04	Biomedical Instrumentation and Applications	3	0	0	3	VII
5.	18EIO05	PLC Programming and Its Applications	3	0	0	3	VII
6.	18EIO06	Measurements and Instrumentation	3	0	0	3	VIII
7.	18EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	VIII

18EGT11 - ENGLISH FOR COMMUNICATION I

(Common to all Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	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 B1 level in the Common European Framework (CEFR).	
Unit - I	**Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – I:**	**9**
Listening - People talking about their 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.		
Unit - II	**Listening, Speaking, Reading and Writing. 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.		
Unit - III	**Listening, Speaking, Reading and Writing. 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.		
Unit - IV	**Listening, Speaking, Reading and Writing. 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.		
Unit - V	**Listening, Speaking, Reading and Writing. 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.		

Total: 45

TEXT BOOK:

1. Jack C. Richards, "Interchange, Student's Book 2", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1. Jack C. Richards & Theodore Rodgers, "Approaches and Methods in Language Teaching", 3rd Edition, Cambridge University Press, New York, 2014.
2. Penny Ur, "A Course in English Language Teaching", 2nd Edition, Cambridge University Press, New York, 2012.

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		3	47	17		33	100
CAT2			37	23		40	100
CAT3		3	47	33		17	100
ESE		2	42	27		29	100

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

18MAC11 - MATHEMATICS I

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	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, multivariable functions and differential equations.	
Unit - I	**Matrices:**	**9**
Introduction to Matrices in Engineering – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation – Applications of Eigen values and Eigen vectors: Electric circuit – Mass string problems.		
Unit - II	**Multivariable Calculus:**	**9**
Functions of two 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 - III	**First Order Ordinary Differential Equations:**	**9**
Solutions of differential equations in variables separable form – Exact differential equations – Linear first order differential equations – Bernoulli's equation – Clairaut's equation.		
Unit - IV	**Ordinary Differential Equations of Higher Order:**	**9**
Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax, sinax – x^n – e^{ax} x^n , e^{ax} sinbx and e^{ax} cosbx – x^n sinax and x^n cosax – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre' s equation.		
Unit - V	**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).		

List of Exercises / Experiments:

1.	Introduction to MATLAB
2.	Matrix operations : Addition, Multiplication, Transpose and Inverse
3.	Computation of eigen values and eigen vectors
4.	Finding ordinary and partial derivatives
5.	Computing extremes of a single variable function
6.	Plotting and visualizing single variable functions
7.	Solving first and second order ordinary differential equations
8.	Solution of Simultaneous first order ODEs

***Alternate Weeks**

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

TEXT BOOK:

1.	Grewal B. S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2011.

REFERENCES:

1.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
2.	Won Y. Yang, Young K. Choi, Jaekwon Kim, Man Cheol Kim, Jin Kim H. and Taeho Im, "Engineering Mathematics with MATLAB", 1st Edition, CRC Press, London, 2018.

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	compute extremal values which arise in function of several	Understanding (K2)
CO3	identify the appropriate method for solving first order ordinary differential equations	Applying (K3)
CO4	solve higher order linear differential equations with constant and variable coefficients	Applying (K3)
CO5	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems	Applying (K3)
CO6	determine eigen values and eigen vectors of a given matrix using MATLAB	Applying (K3), Manipulation (S2)
CO7	compute maxima and minima of a single variable function, plot and visualize single variable function using MATLAB	Applying (K3), Manipulation (S2)
CO8	solve first and second order ordinary differential equations and simultaneous first order ordinary differential equations 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	2	1										
CO2	3	2												
CO3	3	3	1	1										
CO4	3	3	1	1										
CO5	3	3	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	20	10	70				100
CAT2	20	10	70				100
CAT3	20	10	70				100
ESE	20	10	70				100

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

18PHC11 - APPLIED PHYSICS

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	BS	3	0	2*	3.5

Preamble	This course aims to impart the essential concepts of properties of matter, acoustics, ultrasonics, quantum physics, laser and fibre optics, 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	**Properties of Matter:**	**9**
Elasticity: Stress – Strain – Hooke's law – Stress-strain diagram – Poisson's ratio - Modulus of elasticity - Beams – Bending of beams – Expression for bending moment - Cantilever – Depression of the loaded end of a cantilever - Young's modulus by uniform and non-uniform bending methods - I-shaped girders. Viscosity: Viscous force – Viscosity – Co-efficient of viscosity – Importance of viscosity of liquids (qualitative).		
Unit - II	**Acoustics and Ultrasonics:**	**9**
Acoustics: Sound - Reverberation and reverberation time – Growth and decay of sound and Sabine's formula (qualitative) - Absorption coefficient - Factors affecting acoustics of buildings and their remedies. Ultrasonics: Properties of ultrasonic waves - Production of ultrasonic waves - Magnetostrictive generator - Piezoelectric generator - Applications of ultrasonic waves in non destructive testing.		
Unit - III	**Thermal and Quantum Physics:**	**9**
Thermal Physics: Modes of heat transfer - Thermal conductivity - Radial and cylindrical heat flow - Conduction through compound media (series and parallel). Quantum Physics: Matter waves - Schrodinger's time independent and time dependent wave equations – Physical significance of wave function - Particle in a one dimensional box.		
Unit - IV	**Laser, Fibre Optics and Applications:**	**9**
Laser and Applications: Spontaneous emission and stimulated emission - Population inversion - Pumping methods - Einstein's coefficients - Nd:YAG laser - Holography. Fiber Optics and Applications: Principle of propagation of light through optical fibers - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optical communication links (block diagram).		
Unit - V	**Crystal Physics:**	**9**
Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures - Crystal imperfections: line and surface imperfections.		

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 viscosity of a given liquid using Poiseuilles' method.
3.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer.
4.	Determination of the wavelength and the angle of divergence of a semiconductor laser.
5.	Determination of the acceptance angle and the numerical aperture of a given optical fiber.

***Alternate Weeks**

Lecture:45, Practical:15, Total:60

TEXT BOOK:

1. Tamilarasan K. and Prabu K., "Engineering Physics - I", 3rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

REFERENCES:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
2. Mehta and Neeraj, "Applied Physics for Engineers", 1st Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2011.
3. Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 3rd Edition, SCM Publishers, Erode, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of the concepts of elasticity and bending moment of a beam to a simple structure under simple loading to compute the Young\'s modulus of a material, and to explain the concepts of viscosity of liquids.	Applying (K3)
CO2	apply the concepts of growth and decay of sound energy in a hall to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic waves and non-destructive testing using ultrasonic waves.	Applying (K3)
CO3	use the concepts of heat flow to explain heat conduction through materials, and to describe the behavior of electrons in a metal by means of quantum physics.	Applying (K3)
CO4	apply the concepts of laser 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 fiber optic communication link.	Applying (K3)
CO5	explain seven crystal systems, atomic packing factor of the select crystal systems and the types of crystal defects.	Understanding (K2)
CO6	determine the Young\'s modulus of a material using the concepts of elasticity and bending moment of a beam, and to determine the viscosity of a liquid using the concepts of viscosity.	Applying (K3), Precision (S3)
CO7	compute the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using the concepts of propagation of sound through a medium.	Applying (K3), Precision (S3)
CO8	determine the wavelength and the angle of divergence of a semiconductor laser beam using the concepts of propagation of light through a medium, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concept of total internal reflection.	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	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	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	20	40	40				100
CAT2	20	45	35				100
CAT3	20	50	30				100
ESE	20	40	40				100

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

18CYC11 - 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	2*	3.5

Preamble	Applied Chemistry course imparts the basic principles and concepts of chemistry in the field of Engineering and Technology. It also imparts knowledge on Water Technology, Electrochemistry, Corrosion and its control, Fuels & Combustion and Polymers.	
Unit - I	**Water Technology:**	**9**
Introduction - Sources of water - Impurities in water - Types of water – Water Quality Standards - Hardness of water - Expression of hardness - Units of hardness - Estimation of hardness of water by EDTA method - Determination of alkalinity - Disadvantages of using hard water - Boiler troubles - Scale and sludge - Softening of water - External treatment method - Demineralization process - Internal treatment process - Carbonate and Calgon conditioning - Desalination by reverse osmosis method.		
Unit - II	**Electrochemistry:**	**9**
Introduction - Cells - Representation of a galvanic cell - Reversible and irreversible cells - Electrode potential - Nernst equation - Reference electrode - Standard hydrogen electrode - Glass electrode - Electrochemical series and its applications - Conductometric titrations - Mixture of weak and strong acid vs strong base.		
Unit - III	**Corrosion and its Control:**	**9**
Introduction - Chemical corrosion - Electrochemical corrosion - Galvanic corrosion - Concentration cell corrosion - Galvanic series - Factors influencing rate of corrosion - Corrosion control methods - Sacrificial anodic method - Protective coatings - Pretreatment of metal surface - Metallic coating - Electroplating - Nonmetallic coating - Phosphate coating - Organic coating - Paints - Constituents and their functions - Special paints - water repellant and luminescent paints.		
Unit - IV	**Fuels and Combustion:**	**9**
Introduction - Classification of fuels - Requirements of a good fuel - Combustion - Principle of combustion - Calorific value - Gross and net calorific values - Explosive range - Spontaneous ignition temperature - Calorific intensity - Solid fuels - Coal and its varieties - Proximate analysis - Significance - Metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - Refining of petroleum - Manufacture of synthetic petrol - Hydrogenation of coal - Bergius method - Knocking - Octane number - Cetane number - Gaseous fuel - LPG.		
Unit - V	**Polymers:**	**9**
Introduction - Classification of polymers - Functionality - Polymerization - Plastics - Types - Thermo and thermosetting plastics - Individual polymers - Polypropylene, PVC, PET and epoxy resin - Preparation, properties and uses - Compounding of plastics - Fabrication of plastics - Compression, injection, extrusion and blow moulding methods - Foamed plastics.		

List of Exercises / Experiments:

1.	Estimation of total, temporary and permanent hardness of water by EDTA method.
2.	Estimation of Ca2+ and Mg2+ hardness separately by EDTA method.
3.	Estimation of alkalinity of the given water sample.
4.	Conductometric titration - Mixture of acids.
5.	Estimation of hydrochloric acid using pH meter.

***Alternate Weeks**

Lecture:45, Practical:15, Total:60

TEXT BOOK:

1. Palanisamy P.N., Manikandan P., Geetha A. & Manjula Rani K., "Applied Chemistry", 5th Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

REFERENCES:

1. Jain & Jain, "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2016.
2. Sharma B.K., "Industrial Chemistry", Krishna Prakasan Media Pvt. Ltd, Meerut, 2014.
3. Palanisamy P.N., Manikandan P., Geetha A & Manjula Rani K., "Chemistry Laboratory Manual", Rajaganapathy Publishers, Erode, 2018.

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 to construct cells and measure the electrode potential	Applying (K3)
CO3	adopt the suitable corrosion control methods for the given practical 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)
CO6	estimate the amount of hardness for the given water sample by EDTA method	Applying (K3), Precision (S3)
CO7	estimate the amount of alkalinity for the given water sample	Applying (K3), Precision (S3)
CO8	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	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2												
CO5	3	2												
CO6	3	2	1	3										
CO7	3	2	1	3										
CO8	3	2	1	3										

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

ASSESSMENT PATTERN - THEORY

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

18GET11 - INTRODUCTION TO ENGINEERING

(Common to All Engineering and Technology Branches)

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

Preamble	The objective of this course is to realize the importance of engineering, measurements and the fundamental concepts of common engineering disciplines like Civil, Mechanical, Electrical and Electronics Engineering.	
Unit - I	**Engineering and Measurements:**	**9**
Engineering and Measurements: Engineering - Engineer and Engineering Graduate - Graduate attributes - Role of engineer - Professional bodies and their role. Physical Quantities - Dimensions - SI Units, Symbols and Conversions - Mechanical Measuring Instruments - Electrical Measuring Instruments - Accuracy and Precision - Data Acquisition System.		
Unit - II	**Mechanical Engineering:**	**9**
Mechanical Engineering: IC Engines - Power Plants - Boilers and Furnaces - Pumps - Refrigeration and Air Conditioner - CAD/CAM - Additive Manufacturing. Hybrid Electric Vehicles, Industry 4.0.		
Unit - III	**Civil Engineering:**	**9**
Civil Engineering: Selection of the site for Building - Building approval process - Contract and tenders - Building Materials - Components of Building - Sequence of works for building construction - Prefabricated Structures - Water Management - Rainwater harvesting - Infrastructure - Bridges, Dams and Roads.		
Unit - IV	**Electrical Engineering:**	**9**
Electrical Engineering: Terminologies - Current, voltage, potential difference, power, energy - Supply: DC, AC - single phase and three phase - Energy conversion - Utility structure - Single line diagram of power system - Apparatus - Tariff - House wiring. Alternator - Induction motor - Solar and wind energy.		
Unit - V	**Electronics Engineering:**	**9**
Electronics Engineering: Resistor, Inductor, capacitor - Diode - LEDs - Rectifier - Power Supply - Transistor - Transistor as an amplifier - MOSFET - Logic Gates - Microprocessor - Micro controller - Radio communication - Internet of Things.		

Total:45

TEXT BOOK:

1. Faculty of Mechanical Engineering, "Introduction to Engineering", McGraw Hill Education India Pvt. Ltd., Chennai.

REFERENCES:

1. Arvid R. Eide, Roland D. Jenison, Steven K. Mickelson and Larry L. Northup. , "Engineering Fundamentals and Problem Solving", 7th Edition, McGraw Hill Education, New York, 2018.
2. Navaneethakrishnan P., Selvakumar P., Rajeshkumar G. and Sangeetha R.K., "Basic Civil and Mechanical Engineering", McGraw Hill Education, New Delhi, 2016.
3. Senthilnathan N., Logeswaran T. and Suresh M., "Basic Electrical and Electronics Engineering", McGraw Hill, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	recognize the roles of engineer, measurement quantities and systems in Engineering	Understanding (K2)
CO2	infer the components and principles of mechanical engineering applications	Applying (K3)
CO3	summarize the process involved in building construction, infrastructure and water conservation	Applying (K3)
CO4	recognize the fundamental terms involved in electrical engineering	Understanding (K2)
CO5	explain the working of basic electronic components and its 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										3		
CO2	3	2	1	1		2	1					3		
CO3	3	2	1	1		2	1					3		
CO4	2	1										3		
CO5	3	2	1	1								3		

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

ASSESSMENT PATTERN - THEORY

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

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

18CSC11 - PROBLEM SOLVING AND PROGRAMMING
(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	2	0	2	3

Preamble	This course mainly focuses on the basic concepts of computing, the methodology of problem solving and developing skills in programming using C language.	
Unit - I	**Introduction to Computer and Problem Solving:**	**6**
Overview of computers - Applications of computers - Characteristics of computer - Basic computer Organization - Number System - Problem solving: Planning the computer program – Algorithms - Flowcharts – Pseudocodes - Structuring the logic.		
Unit - II	**Case Study on Problem Solving:**	**6**
Algorithm, Flowchart and Pseudo code for the problems: Exchanging the values of two variables - Finding the biggest number - Counting - Summation of numbers - Factorial computation - Generation of Fibonacci Sequence - Summation of series - Base Conversion - Reversing the digits of an Integer.		
Unit - III	**Introduction to C and Control Statements:**	**6**
Overview of C - Basic structure of a C Program - Executing a C Program - C Character set - Tokens - Keywords and Identifiers - Constants - Variables - Data types - Storage classes - Managing Input and Output operations - Operators and Expressions - Decision making and Branching - Looping - Break and continue statements.		
Unit - IV	**Arrays, Strings and Structures:**	**6**
Arrays - One dimensional and Two dimensional arrays - Handling of character strings: Declaring and initializing string variables - Performing simple string operations - Introduction to structures: Structure definition - Structure declaration - Accessing a structure member - Structure initialization - Unions.		
Unit - V	**Functions:**	**6**
User defined functions: Elements of user defined functions - String handling functions - Library functions (strings and characters manipulation) - Passing arguments to functions – Recursion. Introduction to Pointers: Understanding pointers - Accessing address of a variable - Declaring pointer variables - Initialization of pointer variables - Accessing a variable through its pointer - Parameter passing mechanisms.		

List of Exercises / Experiments :

1.	Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential, selective and repetitive structures
2.	Programs for demonstration of working of different types of operators like arithmetic, logical, relational and ternary operators involving sequential structures
3.	Demonstration of programs using decision making statements namely ‘if’, ‘else if’, ‘switch’, conditional and unconditional ‘goto’ (selective structures)
4.	Programs for demonstrating repetitive control statements like ‘for’, ‘while’ and ‘do-while’ (iterative structures)
5.	Demonstration of programs for declaration, initialization and performing operations on one-dimensional and two-dimensional numeric arrays
6.	Demonstration of programs for implementing various string operations like ‘copy’, ‘finding length’, ‘compare’, ‘concatenate’ with and without built-in library functions.
7.	Demonstration of programs for making use of user-defined data types namely structures and unions
8.	Demonstration of modular programming concepts using functions – developing programs using built-in and user-defined functions and parameter passing mechanisms

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	"Problem Solving and Programming", compiled by Department of CSE, Kongu Engineering College, Internal circulation, 2017.

REFERENCES:

1.	Dromey R.G., "How to Solve it by Computer", Pearson Education, 2009.
2.	Balagurusamy E., "Fundamentals of Computing and Programming", Tata McGrawHill Education Pvt. Ltd., 2017.

	COURSE OUTCOMES: On completion of the course, the students will be able to	**BT Mapped (Highest Level)**
CO1	outline the characteristics, organisation, working principles and applications of computers	Understanding (K2)
CO2	express the solution for the given real world problems in terms of algorithm, flowchart and pseudocode	Applying (K3)
CO3	identify the appropriate looping and control statements in C for providing the solution to the given problems	Understanding (K2)
CO4	demonstrate the usage of arrays, strings and structures to solve the given problems	Understanding (K2)
CO5	apply fundamental modular programming knowledge to solve the given problems and recall the basic concepts of pointers	Understanding (K2)
CO6	demonstrate the execution of flowchart for the given problem using Raptor	Applying (K3), Precision (S3)
CO7	demonstrate the application of control statements using simple C programs	Applying (K3), Precision (S3)
CO8	implement solutions to the given problem using user defined functions and data types	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2	2	2	2		2									
CO3		2	1											
CO4		2	1											
CO5		2	1											
CO6	3	2	1	1	1					1				
CO7	3	2	1	1	1					1				
CO8	3	2	1	1	1					1				

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	15	25				50
CAT2	5	15	30				50
CAT3	5	15	30				50
ESE	20	30	50				100

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

18VEC11 - VALUE EDUCATION

(Common to All Engineering and Technology Branches)

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

Preamble	The aim of the course is to make the students to understand the purpose and value of life and to exhibit positive human values.	
Unit - I	**Philosophy of Life Science:**	**4**
Life - Purpose of life (four stages of life) - Philosophy of life (who am I') – Law of nature (cause of the life and body) - Content of the Life (five sheaths) - Goal of life. Five duties in life. Methodology: Life and messages of spiritual and national leaders - The forgotten hero, etc. Project report: Complementing with happiness - Every soul is potentially divine.		
Unit - II	**Human Values - Moral Foundation:**	**4**
Truth, forgiveness, compassion, endurance, humility, non violence,moderate diet, non stealing, self purification, self discipline, self study, content, cleanliness, honesty, and totality in faith - Good habits - Attitude forming for Individual peace. Practical Methods: Personal experience with above characters, Puranic Stories - Self resolve diary maintenance.		
Unit - III	**Social Values:**	**4**
Family - Family System - Greatness of women - World brotherhood (vasudeiva kudumbagam) - Glorious Bharath - Bharathian systems - Past-Present-Future - Team spirit - Goal setting - Economics - Education - Politics - Responsibilities of people - Preserving natural resources. Methodology: Preparing an album on glorious Bharath Past, Present and Future Plans. Goal setting - Management Games.Team Spirit - Yogic Games.		
Unit - IV	**Development of Mental Prosperity:**	**4**
Prosperity of mind - Functions of mind - Obstacles of mind - Practical method to perfect mind is yoga - Types - Uses - Precaution - Contradiction - Kriyas - Asanas - Pranayamas - Meditative techniques. Methodology: Asana - Pranayama - Cyclic meditation - Nada anu sandhana - Meditation - Yogic games for memory. Album on asanas, pranayama and mantra.		
Unit - V	**Maintenance of Physical Health:**	**4**
Human body - Structure - Ten Systems of the body as per modern science.Five elements - Harmonious relationship - Life force - Conserving vitality and health through natural life -Pranic food and its importance - Uses of herbs - Right way of cooking to preserve nutrients - Cause of the disease - Acute and chronic - Disease - Life and death. Methodology: Natural food making, traditional millet dishes. Asanas, pranayamas, cleansing procedures, Quiz on healthy living, Uses of herbs or kitchen garden.		

List of Exercises / Experiments:

1.	List of Loosening Exercises: Neck Movements, Shoulder Joint Movements, Elbow Joint Movement, Wrist Joint Movements, Finger Joint Movements, Rip Joint Movement, Hip Joint Movements, Spinal Cord Movement, Knee Joint Movements, Ankle Joint Movements, Toe Joint Movements.
2.	List of Asanas: Surya Namaskara, Shavasana, Makarasanas, Uttanpadasana, Pawanamuktasana, Sedubandasana, Naukasana, Vipareetakarani, Bhujangasana, Sarpasana, Shalabasana, Dhanurasana, Padmasana,Parvatasana, Vakrasana, Janu Sirashasana, Ustrasana, Yoga Mudra, Meru Tandasana, Tadasana, Katichakrasana, Paadahastasana, Parivarta Trikonasana, Ardha Chakrasana, Viruksasana.
3.	List of Pranayamas: Naadi Sodhana Pranayama, Bhastrika Pranayama, Bhramari Pranayama, Sheetali Pranayama.

Lecture:20, Practical:10, Total:30

TEXT BOOK:

1. Value Education, "Compiled by Vethathiri Maharishi Institute for Spiritual and Intuitional Education", Aliyar, Pollachi, 2018.

REFERENCES:

1. Value Education - Yoga Practical Guide, "Compiled by Padmasoorya Naturopathy and Yoga Foundation", Coimbatore, 2018.

	COURSE OUTCOMES: On completion of the course, the students will be able to	**BT Mapped (Highest Level)**
CO1	understand the purpose and value of life.	Understanding (K2)
CO2	exhibit positive human values.	Understanding (K2)
CO3	understand social values.	Understanding (K2)
CO4	take steps to develop mental and physical health	Applying (K3), Imitation (S1)

Mapping 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		
CO2						3		3				3		
CO3						3		3				3		
CO4														
CO5														
CO6						3		3				3		
CO7														
CO8														

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1							0
CAT2							0
CAT3							0
ESE	25	75					100

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

18EGT21 - ENGLISH FOR COMMUNICATION II

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at B1 level in the 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, "Interchange, Student's Book 3", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1. Jane Willis, "A Framework for Task Based Learning", Longman, Harlow, 1996.
2. Rod Ellis, "Task Based Language Learning and Teaching", Oxford University Press, London, 2003.

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	3	3	30	40		24	100
CAT2	3	3	33	43		18	100
CAT3	3	3	33	43		18	100
ESE	3	3	31	45		18	100

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

18MAC21 - MATHEMATICS II

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	3	1*	2*	4

Preamble	To impart the knowledge of 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	**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 - II	**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 and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.		
Unit - III	**Beta and Gamma Functions:**	**9**
Definition of beta and gamma Functions – Properties – Relation between beta and gamma functions – Transformations of gamma function – Applications of beta and gamma functions: Evaluation of definite integrals in terms of beta and gamma functions.		
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 – 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.	Evaluating indefinite and definite integrals
2.	Evaluating double and triple integrals
3.	Finding the area between two curves
4.	Computing gradient, divergence and curl
5.	Computation of beta and gamma functions
6.	Applying Milne-Thomson method for constructing analytic function
7.	Determination of Mobius transformation for the given set of points
8.	Finding poles and residues of an analytic function

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

TEXT BOOK:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, New Delhi, 2014.

REFERENCES:

1. Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - II", 2nd Edition, Pearson India Education, New Delhi, 2018.
2. Won Y. Yang, Young K. Choi, Jaekwon Kim, Man Cheol Kim, Jin Kim H. and Taeho Im, "Engineering Mathematics with MATLAB", 1st Edition, CRC Press, London, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Solve problems involving double and triple integrals	Understanding (K2)
CO2	Apply the concept of vectors in engineering problems	Applying (K3)
CO3	Use Beta and Gamma functions to improper evaluate integrals	Applying (K3)
CO4	Identify, construct and apply analytic functions in electrostatics and fluid flow problems	Applying (K3)
CO5	Evaluate complex integrals which is extensively applied in engineering	Applying (K3)
CO6	Evaluate line, double and triple integrals and determine area between two curves using MATLAB	Applying (K3), Manipulation (S2)
CO7	Compute gradient, curl and divergence of a vector function 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	2	2											
CO2	3	2												
CO3	3	2	1											
CO4	3	1												
CO5	3	2	2											
CO6					3									
CO7					2									
CO8					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	10	70				100
CAT2	20	10	70				100
CAT3	20	10	70				100
ESE	20	10	70				100

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

18PHC25 - MATERIALS SCIENCE AND OPTO ELECTRONIC DEVICES
(Common to EEE & EIE branches)

Programme & Branch	B.E. & Electronics & Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	BS	3	0	2*	3.5

Preamble: This course aims to impart the knowledge on the physics of conductors, superconductors, semiconductors, magnetic materials, dielectrics, optoelectronic materials, nano materials, biocompatible and thermoelectric materials. It also describes the working of the select optoelectronic devices and the applications of aforementioned materials in electrical and electronics, and instrumentation engineering and provides motivation towards innovations.

UNIT – I		9

Conducting and Superconducting Materials: Conducting Materials: Introduction - Classical free electron theory - Electrical conductivity - Quantum free electron theory of metals - Fermi distribution function - Effect of temperature on Fermi function - Energy band theory of solids (qualitative). Superconducting Materials: Properties - Type I and Type II superconductors - Applications: Magnetic levitation.

UNIT – II		9

Semiconducting and Dielectric Materials: Semiconducting Materials: Types of semiconductor - Intrinsic semiconductor: Carrier concentration - electrical conductivity and band gap (qualitative) - Extrinsic semiconductors: Carrier concentration in n-type and p-type semiconductors (qualitative). Dielectric Materials: Dielectric constant - Types of polarization (qualitative) – Frequency and temperature dependence of polarization - Concepts of dielectric loss and dielectric breakdown - Uses of dielectric materials in capacitor.

UNIT –III		9

Magnetic and Nano Materials: Magnetic Materials: Origin of magnetism - Types of magnetic materials – Domain theory of ferromagnetism – Hysteresis - Soft and hard magnetic materials – Transformer core. Nanomaterials: Low dimensional structures - quantum dot, quantum wire and quantum well – Synthesis: Top down and bottom up approaches – Lithographic method – Physical vapor deposition method - Applications of Nanomaterials.

UNIT – IV		9

Optoelectronic Materials and Devices: LED: Materials, principle, construction and working – LDR: Materials, principle, construction and working - Solar cell: principle, construction and working - Birefringence crystals: Opto-electric effect - Electro-optic amplitude modulator: Franz –Keldysh and Stark effect modulators.

UNIT – V		9

Biocompatible and Thermoelectric Materials: Biocompatible Materials: Biocompatibility - Ni-Ti alloy and their applications - Thermoelectric Materials: Physics of thermoelectricity, Peltier, Seebeck and Thomson effects - Thermoelectric generators.

List of Experiments:

1. Determination of the specific resistance of a material using Carey –Foster's bridge.
2. Determination of the band gap of a semiconductor using post office box.
3. Determination of the thickness of a nano-structured thin film using air-wedge arrangement.
4. Determination of hysteresis loss in a ferromagnetic material.
5. Determination of thermo emf of a thermocouple.

Lecture:45, Practical: 15, Total: 60

TEXT BOOK:

1. Tamilarasan K. and Prabu K., "Engineering Physics-II", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

REFERENCES / MANUAL:

1. Raghavan V., "Materials Science and Engineering: A first course", 5th Edition, Prentice-Hall of India, New Delhi, 2009.
2. Che C.H., "Ultrasonic and Advanced Methods for Nondestructive Testing and Materials Characterization", World Scientific Pub. Co. Inc., Chennai, 2007.
3. Tamilarasan K. and Prabu K., "Physics Laboratory Manual", SCM Publishers, Erode, 2018.

* Alternate week

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 compute the electrical conductivity of metals and to explain band theory of solids, and to expound the types, properties, applications of superconductor and the working of magnetic levitation	Applying (K3)
CO2:	use the concept of density of states to elucidate the types and innate characteristics of semiconductor, and to describe the phenomena related to dielectrics and their select applications	Applying (K3)
CO3:	outline the attributes of magnetic materials, the features and the select preparation methods of nano materials with their application	Understanding (K2)
CO4:	make use of the theory of p-n junction to interpret the materials, construction, working and applications of optoelectronic devices (LED, LDR and solar cell) and the application of Opto-electric effect in modulator	Applying (K3)
CO5:	rephrase the phenomenon related to the select biocompatible materials, thermoelectric materials and their applications	Understanding (K2)
CO6:	determine the specific resistance of conducting materials and the band gap of semiconducting materials using the concept of electrical conductivity	Applying (K3), Precision (S3)
CO7:	determine the thickness of nano-crystalline thin films using the concept of interference of light	Applying (K3), Precision (S3)
CO8:	determine the hysteresis loss in a ferromagnetic materials using the concept of domain theory of ferromagnetism, and to determine the thermo emf of a thermocouple using the concepts of Seebeck, Peltier and Thomson effects	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	1											
CO3	3	2												
CO4	3	2	1											
CO5	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	20	40	40				100
CAT2	20	45	35				100
CAT3	25	45	30				100
ESE	20	40	40				100

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

18CYC24 - ENVIRONMENTAL SCIENCE AND FUEL CELLS
(Common to ECE & EIE branches)

Programme & Branch	BE - Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Chemistry	2	BS	3	0	2*	3.5

Preamble: Environmental Science aims to realize the interdisciplinary and holistic nature of the environment for engineering students and stimulate them to know about environment, batteries, fuel cells, e-waste management and environmental impact assessment for sustainable development.

UNIT - I		9

Environmental Pollution: Environment - planet earth - components of environment- atmosphere-hydrosphere-lithosphere-biosphere-interrelationship between components and sub components - environmental pollution - environmental pollutants - sources, effects and control methods of air, water, soil and noise pollution - role of an individual in prevention of pollution - case studies.

UNIT – II		9

Ecosystems and Biodiversity: Ecosystems - definition - concept of an ecosystem – components of an ecosystem - structural and functional features – energy flow in the ecosystem- functional attributes (food chain and food web only) – introduction, types, characteristic features, structure and functions of the (a) forest ecosystem (b) aquatic ecosystems (ponds, rivers and oceans) - Biodiversity - introduction – classification –values of biodiversity - India as a mega diversity nation - biodiversity at global, national and local level- hotspots of biodiversity – threats to biodiversity – endangered and endemic species of India – in-situ and ex-situ conservation of biodiversity.

UNIT – III		9

Batteries and Fuel Cells: Introduction - types of batteries - primary batteries**-** lechlanche cell - secondary batteries **-** construction and working of lead acid and nickel-cadmium batteries - classification, description, principle, components and applications of alkaline fuel cells, phosphoric acid and molten carbonate – hydrogen - advantages of using hydrogen as alternate fuel.

UNIT – IV		9

E-Waste and its Management: 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 - case studies.

UNIT – V		9

Environmental Impact Assessment and Auditing: Sustainability -three pillars of sustainability- factors affecting environmental sustainability-approaches for sustainable development - Introduction to EIA - objectives of EIA - steps in EIA - participants of EIA - general approach of environmental auditing - audit programmes in India - ISO 14001 certification - environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act.

List of Experiments:

1. Estimation of chloride ion in the given water sample using Argentometric method.
2. Estimation of chromium (Cr^{6+}) in wastewater sample.
3. Determination of dissolved oxygen in the given wastewater sample.
4. Estimation of iron using permanganometry.
5. Estimation of copper in the given solution by Iodometric method.

***Alternate Weeks**

Lecture:45, Practical:15, Total: 60

TEXT BOOK:

1. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya V.N., “Environmental Science”, Pearson Education, New Delhi, Revised Edition 2019.

REFERENCES / MANUAL:

1. Rakesh Johri, “E-waste: implications, regulations, and management in India and current global best practices”, The Energy and Resources Institute (TERI), 2013.
2. Charles H. Eccleston, “Environmental Impact Assessment: A Guide to Best Professional Practices”, CRC Press, 2017.
3. Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., “Chemistry Laboratory Manual”, Rajaganapathy Publishers, Erode, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	manipulate the sources, effects and control methods of various environmental pollution	Applying (K3)
CO2:	elaborate the features of ecosystems and biodiversity to find the need for conservation	Understanding (K2)
CO3:	apply the concepts of batteries, fuel cells and its applications in various field	Applying (K3)
CO4:	utilize the knowledge to handle the e-waste and reduce its impacts on environment	Applying (K3)
CO5:	make use of the knowledge of EIA, EA and environmental legislation laws towards sustainability	Applying (K3)
CO6:	determine the amount of iron in the given solution using permanganometry	Applying (K3), Precision (S3)
CO7:	determine the amount of chloride and copper in the given solution	Applying (K3), Precision (S3)
CO8:	estimate the amount of chromium and DO in the given wastewater	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1			3							
CO2	3	2					2							
CO3	3	2	1	1			3							
CO4	3	2	1	1			3							
CO5	3	2	1	1			3							
CO6	3	2	1	3										
CO7	3	2	1	3										
CO8	3	2	1	3										

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

ASSESSMENT PATTERN - THEORY

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

18MEC11 - ENGINEERING DRAWING
(Common to all Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	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**
General Principles of Orthographic Projection: 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 Solid: 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: 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 Surfaces: 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**
Isometric Projection and Introduction to AutoCAD: 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.		

Total:45

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	20	40	40				100

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

18EIT21 - PRINCIPLES OF MEASURING INSTRUMENTS

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

Preamble: To make the students to learn the Principles, Constructions, Characteristics and Errors of measuring instruments.

UNIT – I		9

Science of Measurements: Significance of Measurements –Methods of Measurements: Direct and Indirect methods, Classification of Instruments: Absolute and Secondary, Deflection and Null Type Instruments. Functions of Instruments and measurement systems. Elements of a generalized measurement system.

UNIT – II		9

Construction of Measuring Instruments: Basic forces for indicating instruments: Deflecting, Controlling and Damping – Principles and operation of permanent magnet and moving coil instrument – moving iron instrument - attraction and repulsion - comparison.

UNIT – III		9

Characteristics of Measuring Instruments: Static Characteristics: Accuracy and Precision – Range and Span – Threshold and Resolution - Sensitivity – Linearity – Drift – Reproducibility – Hysteresis- dead zone- Loading effect. Introduction to Dynamic Characteristics.

UNIT – IV		9

Errors in Measurement and Statistical Analysis: Classification of Errors: Gross Errors, Systematic Errors, Random Errors. Statistical Methods: Arithmetic mean, Range, Deviation, Variance - Specifying odds – Uncertainty Analysis and treatment of single sample data, Limiting Errors.

UNIT – V		9

Application of Measuring Instruments: Measurement of current and voltage using Ammeter, Voltmeter, Multimeter. CRO: Principle- Measurement frequency and Amplitude using Oscilloscope.

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Murty D.V.S., “Transducers and Instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
2. Kalsi H.S., “Electronic Instrumentation”, 3rd Edition, Tata McGraw-Hill Education, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain the significance of measurement	Understanding (K2)
CO2:	summarize the principles of measuring instruments	Understanding (K2)
CO3:	explain the characteristics of measuring instruments	Understanding (K2)
CO4:	identify the errors in measuring instruments	Understanding (K2)
CO5:	apply the instruments for measuring electrical parameters	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	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	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)**

18MEL11 - ENGINEERING PRACTICES LABORATORY
(Common to all Engineering and Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	I	ES	0	0	2	1
Preamble	This course is designed to provide a hands-on experience in the field of mechanical engineering and electrical engineering such as fitting, plumbing, wood working, sheet metal work, welding, safety aspects, assembly and testing of electrical and electronic circuits.						

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.	To prepare a leak proof sheet metal tray/box/funnel using modern power tools.
6.	Welding practice using welding simulator.
7.	Project: Preparing innovative articles using wood/sheet metal.
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
8.	Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection
9.	Wiring circuit for fluorescent lamp and stair case wiring
10.	Measurement of earth resistance
11.	Soldering of simple circuits and trouble shooting
12.	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	3	3	3	3	3				3	3	2	3		
CO2	3	2	1	1					3	2	2	3		
CO3	2	1							3	2	2	3		
CO4	3	2	1	1					3	3	2	3		
CO5	3	2	1	1					3	2	2	3		

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

18MAC31 - MATHEMATICS III

(Common to Civil Engineering, Mechanical Engineering, Mechatronics Engineering, Automobile Engineering, Electronics And Communication Engineering, Electrical And Electronics Engineering , Electronics And Instrumentation Engineering, Chemical Engineering & Food Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	BS	3	1*	2*	4

Preamble	To provide the skills for solving the real time engineering problems involving partial differential equations and impart knowledge in Fourier transform and Z-Transform.	
Unit - I	**Fourier Series:**	**9**
Dirichlet's conditions – General Fourier series – Change of interval – Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.		
Unit - II	**Partial Differential Equations:**	**9**
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 - III	**Applications of Partial Differential Equations:**	**9**
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges).		
Unit - IV	**Fourier Transform:**	**9**
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**
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.		

List of Exercises / Experiments :

1.	Expressing given function in terms of Fourier series.
2.	Harmonic Analysis of given data.
3.	Solving second order partial differential equations.
4.	Solution of One dimensional wave equation.
5.	Solution of Two dimensional heat equation.
6.	Determining Fourier and inverse Fourier transform of a given function.
7.	Computing Z- transform of a discrete sequence.
8.	Apply Z- transforms to obtain the solution of difference equations.

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

TEXT BOOK:

1. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons Ltd., USA, 2019.
2. Duraisamy C., Vengataasalam S., Arun Prakash K. & Suresh M. , "Engineering Mathematics – III", 2nd Edition, Pearson India Education, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	express given function or data in terms of Fourier series	Applying (K3)
CO2	solve the given standard partial differential equations	Applying (K3)
CO3	apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations	Applying (K3)
CO4	use the mathematical principles of Fourier transforms which will provide the ability to formulate and solve some of the physical problems of engineering	Applying (K3)
CO5	apply Z transform techniques for analyzing linear time invariant systems	Applying (K3)
CO6	express the given data in Fourier series using MATLAB	Applying (K3), Manipulation (S2)
CO7	solve partial differential equations using PDE Modeler	Applying (K3), Manipulation (S2)
CO8	find Fourier and Z-Transforms using MATLAB built in functions	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1									3	3
CO2	3	3	1	1									3	3
CO3	3	3	1	1									3	3
CO4	3	3	1	2									3	3
CO5	3	3	1	2									3	3
CO6					3								3	3
CO7					3								3	3
CO8					3								3	3

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

ASSESSMENT PATTERN - THEORY

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

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

18EIT31 - TRANSDUCERS ENGINEERING

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

Preamble: To learn the Principles, Constructions, Characteristics and Applications of various transducers.

UNIT – I	**Measurements and Instrumentation of Transducers:**	**9**

Review of Functional blocks of a Measurement system – Sensors Vs Transducers. Fundamental and Derived units –Standards of Measurement. Classification of Transducers – Review of static characteristics – Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT – II	**Variable Resistance Transducers:**	**9**

Resistance Potentiometer- Loading effect. Resistance Strain gauges: Unbonded and Bonded type strain gauges – Temperature effects on strain gauges – Measurement of Strain – Strain gauge circuits – Resistance Thermometers –Thermistor – Hot-wire Anemometer – Piezoresistive sensor. Applications: Pressure measurement, Moisture measurement, Humidity measurement.

UNIT – III	**Variable Inductance Transducers:**	**9**

Simple inductance and Mutual inductance Transducers – Induction Potentiometers – Variable reluctance transducer (Microsyn) – Variable reluctance tachogenerator– Variable reluctance accelerometer – Linear Variable Differential Transformers – Eddy current type Inductive Transducers – Synchros – Resolvers. Applications: Pressure Measurement, Thickness Measurement, Position measurement.

UNIT – IV	**Variable Capacitance Transducers:**	**9**

Principle of operation, construction details, Characteristics of capacitive transducers – Applications: Capacitive Thickness Transducers – Capacitive Moisture Transducers – Capacitive Hygrometer – Capacitive Level Transducer – Capacitive Proximity Transducer – Capacitive pressure sensor – Capacitive Strain Transducer – Capacitive Microphone.

UNIT – V	**Special Transducers:**	**9**

Piezoelectric Transducers - Magnetostrictive Transducers –Digital Transducers – Hall Effect Transducers – Fibre Optic Transducers – SQUID Sensors – Safety Sensors – Environmental monitoring Sensors (Water Quality & Air pollution) – Thick & Thin Film sensors – Smart Sensors –MEMS and Nano Sensors.

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Murthy D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of India, New Delhi, 2010.

2. Doebelin E.A., “Measurement Systems: Applications and Design”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2008.

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

18EIT32 - ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

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

Preamble: To impart the knowledge on Principles, Constructions, Dynamics of Electrical and Electronic Measuring Instruments.

UNIT – I	**Measurement of Power and Energy:**	**9**

Electrodynamometer Wattmeter: Construction –Theory- Errors - Low Power Factor Wattmeter- Three Phase Wattmeter- Measurement of power in three phase circuits. Single Phase Induction Type Energy Meters: Construction –Theory and Operation of Single Phase Induction Meter. Testing of Energy Meter: Phantom loading

UNIT – II	**Instrument Transformers:**	**9**

Instrument Transformers: use of Instrument transformers- Ratios-Burden - Current Transformers (C.T) - Design Features of C.T - Effect of Secondary Open Circuit - Potential Transformers (P.T): Construction – Protection - Difference between C.T and P.T. Measurement of Power using Instrument Transformers.

UNIT – III	**DC Null Methods of Measurements:**	**9**

D.C.Potentiometers: Introduction - Basic Potentiometer Circuit – Standardisation - Laboratory type (Crompton's) potentiometer - Applications. Classification of Resistances. Medium Resistance: Wheat stone bridge - limitations. Low Resistance: Kelvin Double Bridge method. High Resistance: Meggar (Earth Tester).

UNIT – IV	**Measurement of Impedance with Bridges:**	**9**

Introduction-Sources and Detectors - General Equation for balance and general form of A.C bridge. Self inductance: Maxwell's inductance bridge, Maxwell's inductance and capacitance, Anderson's bridge. Capacitance: Schering bridge. Frequency: Wien's Bridge. Sources of Errors in bridge circuits.

UNIT – V	**Digital Instrumentation (Block Diagram Approach):**	**9**

Impedance Measurement: Q meter. RMS Measurement: True RMS Meters. Digital meters: Time, Phase, Period and Frequency measurements. Digital Voltmeters: Ramp type Voltmeters. Shielding and Grounding.

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Nakra B.C., Chaudhry K.K., "Instrumentation Measurement and Analysis", 3rd Edition, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2014.
2. Robert B. Northrop, "Introduction to Instrumentation and Measurements", 3rd Edition, CRC Press, UK, 2014.

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 power and energy	Applying (K3)
CO2:	make use of the concepts of potentiometers and instrument transformers for measuring electrical parameters.	Applying (K3)
CO3:	carryout the measurement of resistance using DC bridges.	Applying (K3)
CO4:	carryout the measurement of 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)**

18EIT33 NETWORKS, SIGNALS AND SYSTEMS

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

Preamble: To impart knowledge on electric circuit analysis and synthesis and to provide fundamental concepts of continuous signals and systems.

UNIT – I	Network Theorems:	9+3

DC Circuits: Dependent and independent sources-Source transformation -Star delta transformation-Superposition theorem. Thevenin's theorem - application in transistor biasing circuit-Norton's theorem-Maximum power transfer theorem.

UNIT – II	Network Analysis:	9+3

DC response analysis: Steady state analysis of RL, RC and RLC circuits, Transient analysis of RL RC and RLC circuits. Application of RC transient in Wave shaping circuits- AC steady state analysis: peak, average and rms values of ac quantities - apparent, active and reactive powers - power factor- phasor analysis. Resonance analysis: Ideal RLC series and parallel circuit - application in tuning circuit.

UNIT – III	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: Realisability 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 – IV	Continuous Time Signals and Systems:	9+3

Classification-Signal representation - Odd and Even signals-Energy and Power signals-Periodical signals. Signal transformations-classification of systems: static and dynamic -time variant and invariant – linear and nonlinear - stable and unstable- causal and non causal-recursive and non recursive.

UNIT – V	Analysis of Signals and Systems:	9+3

Relation between Laplace and Fourier transform- Trignometric and exponential form of Fourier series of periodical signals: Full and half wave rectified sinusoidal signal. Fourier transform of aperiodical signals- Parsevals's theorem - Applications of Fourier series in Harmonic analysis-Transfer function of LTI continuous time system using Laplace transform-impulse and step response of LTI system using Laplace transform.

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 Publishing Company, New Delhi, 2015.

REFERENCES:

1. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley Publishers, USA, 2007.

2. Ravish R. Singh, "Networks Analysis and Synthesis", McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	apply theorems to solve DC circuit	Applying (K3)
CO2:	analyze the behavior of RLC circuits in time and frequency domain	Analyzing (K4)
CO3:	analyze and synthesize the network functions	Analyzing (K4)
CO4:	analyze continuous time signals and systems in time and frequency domain	Analyzing (K4)
CO5:	apply Laplace and Fourier transforms in the analysis of 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	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	3	1	1	1								3	3

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

ASSESSMENT PATTERN - THEORY

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

18EIT34 - ELECTRON DEVICES AND CIRCUITS

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

Preamble: To provide information on the characteristics, design and applications of electron devices like diodes, transistors and special devices.

UNIT – I	**Diodes and Special Devices:**	**9**

Review of semiconductor devices - Diode: Volt Ampere characteristics – Clippers, Clampers and Voltage multiplier. Special devices: Zener diode as voltage reference – LCD – LDR – Opto-electronic devices - Surface Mount Devices – OLED.

UNIT – II	**Bipolar Junction Transistor:**	**9**

Bipolar Junction Transistor: Characteristics of BJT – Current gains in the CB, CE and CC configuration - Load line and Operating point – Stability and stability factor: Fixed bias circuits and Voltage - divider bias – BJT small signal model–Analysis of CE, CB, CC amplifiers

UNIT – III	**FET and UJT:**	**9**

Construction and characteristics and applications of JFET –Parameters of JFET – FET in CS, CD and CG Configurations – JFET as voltage controlled resistor – MOSFET:Types and its Characteristics – UJT as relaxation oscillator, Programmable UJT (PUT)

UNIT – IV	**Differential Amplifier, Tuned and Power Amplifier:**	**9**

Differential amplifier using BJT – Differential and common mode gain, CMRR. Tuned amplifiers–Frequency response of single and double tuned amplifier – Classification of power amplifiers – Transformer coupled Class A, Class B and Push Pull amplifiers

UNIT – V	**Applications of Devices:**	**9**

Feedback amplifiers – Principle and advantages of negative feedback amplifiers –Types: Voltage / current, series/shunt feedback amplifiers. Oscillators –Barkhausen criteria – RC oscillators. Multivibrators: Astable, Monostable and Bistable Multivibrators.

Total: 45

TEXT BOOK:

1. David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, New Delhi, 2019.

REFERENCES:

1. Robert L. Boylestad, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson New International Edition, Noida, 2014.
2. Jacob Millman, Christos C. Halkias, Satyabrate Jit, “Electron Devices and Circuits”, 4th Edition, McGraw Hill, India, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	apply diode circuits and special electronic devices for various applications	Applying (K3)
CO2:	determine the characteristics and stability of BJT	Applying (K3)
CO3:	describe the construction and characteristics of FET and UJT	Understanding (K2)
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	2	1	1	1								3	3
CO2	3	2	1	1	1								3	3
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	7	20	73				100
CAT2	10	47	43				100
CAT3	10	47	43				100
ESE	4	40	56				100

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

18EIT35 - DIGITAL LOGIC DESIGN

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

Preamble: To impart the acquaintance about code conversion, Boolean algebra, logic gates, combinational and sequential logic, and converters.

UNIT – I	Boolean Algebra and Minimization of Boolean Expressions:	9+3

Axioms and Laws of Boolean Algebra – Reducing Boolean Expressions – Boolean Functions and their representation- Expansion of a Boolean Expression in SOP, standard SOP, POS and standard POS Form – Conversion of basic logic to universal logic - Minimization of Switching Functions: Two, Three and Four Variable K Maps – Implementation of Logic Functions-Quine McCluskey Method: Don't care condition.

UNIT – II	Combinational Logic Design:	9+3

Design Procedure: Adders – Carry Look Ahead adder - Subtractors. Code converters: Binary to Gray code - Gray code to Binary - BCD to Excess 3 code - Parity bit generators/Checkers - Comparators: 1 bit Magnitude Comparator - Encoders: Octal to Binary Encoder - Decoders: 3 Line to 8 Line Decoder - Multiplexers – Demultiplexers.

UNIT – III	Synchronous Sequential Logic Circuits:	9+3

Latches and Flipflops: Triggering and Characteristics equations of Flipflops- Flipflop Excitation Tables-Conversions. Synchronous Sequential Logic: Analysis of Clocked Sequential Circuits-State Reduction and Assignment – Design Procedure. Synchronous Counters: Design of Synchronous 3-bit Up-down Counter Using J-K FFs- Registers: Universal shift registers-Sequence detector (non-overlapping)

UNIT – IV	Logic Families and Memory:	9+3

Digital IC Specification Terminology: Propagation Delay - Noise Margin –Speed Power Product. Introduction to PLA and PAL-Transistor Transistor Logic (TTL): Two-input TTL NAND Gate – Emitter Coupled Logic (ECL): Inverter. Memory Types and Terminology: Memory Organization and operation - Semiconductor RAMs: Static RAMs (SRAMs) - Dynamic RAMs(DRAMs). Read-Only Memory (ROM)-ROM organization – Types of ROMs- Programmable ROM (PROM)

UNIT – V	Role of Digital Logic in Instrumentation:	9+3

Asynchronous sequential logic analysis and design (Qualitative Analysis only)- Hazards: Static and Dynamic Hazards, Essential Hazards –Hazard free Realisation - Introduction to Digital applications in Instrumentation – Alarms : Single variable alarm , Multivariable alarm: Holding tank level control system - Two Position Control: Digital two position controller using comparators and flip flops.

Lecture:45, Tutorial:15, Total: 60

TEXT BOOK:

1. Morris Mano M., "Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson Education, 2018.

REFERENCES:

1. Anand Kumar A., "Fundamentals of Digital Circuits", 4th Edition, Prentice Hall of India, New Delhi, 2016.
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th 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:	simplify the boolean expressions	Applying (K3)
CO2:	design the combinational circuits	Applying (K3)
CO3:	implement circuits using sequential logic	Applying (K3)
CO4:	identify the role of logic families and memory devices	Understanding (K2)
CO5:	integrate the digital concepts in instrumentation 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								3	3
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	3	1	1	1								3	3

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

ASSESSMENT PATTERN - THEORY

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

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

18EIL31 - DEVICES AND CIRCUITS LABORATORY

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Introduction to Engineering	3	PC	0	0	2	1

Preamble: To construct and verify the circuits using electronic devices

List of Exercises / Experiments :

1. Determine the characteristics of PN junction and Zener diode
2. Determine the characteristics of BJT and its hybrid parameters
3. Determine the characteristics of FET and FET parameters
4. Determine the characteristics of UJT and intrinsic stand-off ratio
5. Build the Clipper and Clamper circuits using diodes and examine the waveforms
6. Verification of Thevenins theorem in voltage divider bias on BJT
7. RC transient response analysis in wave shaping circuits
8. Frequency response analysis of RLC circuits
9. Generate Sine wave using BJT based RC Phase shift oscillator and calculate its frequency
10. Generate Square wave using BJT based Astable Multivibrator and calculate its frequency

Total: 30

REFERENCES / MANUALS / SOFTWARES:

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), Manipulation (S2)
CO2:	generate waveforms using PN junction diode and BJT	Applying (K3), Imitation (S1)
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

18EIL32 - 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 / MANUALS / SOFTWARES:

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	1		1	3	3
CO2	3	2	1	1	1			1	2	1		1	3	3
CO3	3	1	1	3	1			1	2	1		1	3	3

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

18EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION
(Common to all Engineering & Technology Branches)

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

Preamble	This course is designed to impart required levels of fluency in using the English Language at B2 level in the CEFR through activities, hands-on training and application.	
Unit - I	**Listening:**	**6**
Techniques for effective listening - Listening and note taking - Listening activities using listening texts - Listening to discourse samples of native English speakers – Focussed listening for improving pronunciaition - understanding different accents.		
Unit - II	**Reading:**	**6**
Developing reading skills - Reading aloud - Group reading activities - Reading with correct word stress and intonation.		
Unit - III	**Soft Skills:**	**6**
Attitude - Goal setting - Time Management - Team Work - Telephonic conversation skills.		
Unit - IV	**Writing:**	**6**
Making preparatory notes, drafts and PPT"s for laboratory activities - Word editing features - editing and proof reading..		
Unit - V	**Speaking:**	**6**
Verbal and non-verbal communication - Introducing oneself - Introducing others – Mock Interviews - Making presentations on chosen topics - Group Discussion.		

Total:30

REFERENCES/ MANUALS:

1. Kumar, Sanjay and Pushp Lata, "Communication Skills", 2nd Edition, Oxford University Press, New Delhi, 2017.
2. Laboratory Manual.

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		3		
CO2									2	2		2		
CO3									2	2		2		

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

18MAC41 - STATISTICS AND NUMERICAL METHODS

(Common to Civil Engineering, Mechanical Engineering, Mechatronics Engineering, Automobile Engineering, Electrical And Electronics Engineering , Electronics And Instrumentation Engineering, Chemical Engineering & Food Technology Branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	BS	3	1*	2*	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**
Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single mean and difference of means – Small sample tests: Student's t-test for significance of means – F-test for comparison of variances – Chi-square test for goodness of fit and independence of attributes		
Unit - II	**Design of Experiments:**	**9**
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**
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**
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 and backward interpolation formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule.		
Unit - V	**Numerical Solution of First order Ordinary Differential Equations:**	**9**
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.		

List of Exercises / Experiments:

1.	Testing significance of means by student's t - test
2.	Testing the independence of attributes by Chi-square test
3.	Analyze the difference in means is statistically significant by Completely Randomized Design
4.	Finding positive root by Regula – Falsi method
5.	Solving simultaneous linear equations by Gauss – Seidel Method
6.	Evaluating definite integrals by Trapezoidal and Simpson's rules
7.	Solution of ODE by Euler and Modified Euler methods
8.	Solution of ODE by Runge-Kutta method

***Alternate Weeks**

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

TEXT BOOK:

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

REFERENCES:

1. Jay L. Devore. , "Probability and Statistics for Engineering and the Sciences ", 9th Edition, Cengage Learning , USA, 2016.
2. Steven C. Chapra & Raymond P. Canale. , "Numerical Methods for Engineers ", 7th Edition, McGraw-Hill Education, New York, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify large and small samples and apply suitable tests for solving engineering problems	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 ordinary differential equations numerically	Applying (K3)
CO6	test whether the given data is significant by hypothesis testing and ANOVA using MATLAB	Applying (K3), Manipulation (S2)
CO7	use MATLAB for determining numerical solutions of algebraic equations and integral values	Applying (K3), Manipulation (S2)
CO8	obtain the numerical solution of ordinary differential equations 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	2	1	2									3	3
CO2	3	1	2	2									3	3
CO3	3	2	1	1									3	3
CO4	3	1	1	1									3	3
CO5	3	2	1	1									3	3
CO6					3								3	3
CO7					3								3	3
CO8					3								3	3

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

ASSESSMENT PATTERN - THEORY

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

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

18MET46 - THERMODYNAMICS AND FLUID MECHANICS

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

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics, Introduction to Engineering	4	ES	3	0	0	3

Preamble	To know the basic concepts of Laws of thermodynamics, Boilers, Compressors, Refrigeration and overview about the hydraulic machineries	
Unit - I	**Laws of Thermodynamics:**	**9**
Thermodynamic systems – Macroscopic and Microscopic Approach -Boundary– Control volume – System and surroundings – Universe – Properties –State-Process – Cycle – Point and path functions - Equilibrium – Work and heat transfer– Zeroth Law of Thermodynamics -First law of thermodynamics for open and closed systems– SFEE equations [steady flow energy equation].		
Unit - II	**Boilers:**	**9**
Introduction – Formation of Steam – Thermodynamic Properties of Steam, Steam Tables and Charts (Usage). Basic Steam Power Cycle (Simple Rankine Cycle). Boiler: Boiler - Classifications: Fire Tube, Water Tube Boilers-Boiler Mountings and Accessories		
Unit - III	**Compressors:**	**9**
Positive Displacement Compressors – Classifications - Reciprocating Compressors. Rotary Compressor - Types - Roots Blower, Sliding Vane, Centrifugal Compressor, Energy conservation in Compressors.		
Unit - IV	**Refrigeration:**	**9**
Unit of Refrigeration – Components of Refrigeration System- Vapour Compression.Refrigeration Cycle with (p-h) and (T-s) Diagrams – Working of Vapour Absorption Refrigeration System- Coefficient of Performance - Introduction to Psychrometric terms		
Unit - V	**Fluid Machineries:**	**9**
Hydro turbines: Definition and classifications - Pelton turbine - Francis turbine - Kaplan turbine – Working principles – Efficiency. Pumps: Classifications - Reciprocating pump, Centrifugal pump -working principle, - Rotary pumps: working principles of gear and vane pumps.		

Total:45

TEXT BOOK:

1. Rajput R. K.," Thermal Engineering ", 10th Edition, Laxmi Publications(P) LTD, New Delhi, 2017 for Units I,II,III,IV.
2. Subramanya K.," Hydraulic Machines ",1st Edition, McGraw Hill Education, New Delhi,2019 for Units V.

REFERENCES:

1. Yunus A.Cengel, & John M.Cimbala, “Fluid Mechanics Fundamentals and Applications”,4th Edition in SI units, Tata McGraw Hill, New Delhi, Special Indian Edition, 2019.
2. Nag P. K., “Engineering Thermodynamics”, 6th Edition Tata McGraw Hill education (India) Private Limited, NewDelhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the first law of thermodynamics for closed and open systems	Applying (K3)
CO2	identify the different types of boilers and calculate the thermal efficiency of steam power plant	Applying (K3)
CO3	classify the types and explain the working principles of compressors	Applying (K3)
CO4	explain the concepts of vapour compression and absorption refrigeration systems	Applying (K3)
CO5	illustrate the working principles of hydraulic turbines and pumps	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		1		1						3	3
CO2	3	3	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	15	60	25				100
CAT2	15	60	25				100
CAT3	15	60	25				100
ESE	15	60	25				100

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

18CST45- DATA STRUCTURES AND ALGORITHMS

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	4	ES	3	0	0	3

Preamble	This is an introductory course for basic Data Structures and Algorithms. It deals with basic concepts and techniques of linear and non-linear data structures	
Unit - I	**List:**	**9**
Data Structures - Abstract Data Types (ADT) - List ADT and Array Implementation -Singly Linked List- Doubly Linked List - Circular Linked List.		
Unit - II	**Stack and Queues:**	**9**
Stack ADT – Operations – Array and Linked List implementation of Stacks – Evaluation of Expressions - Queue ADT – Operations - Array and Linked List implementation of Queues.		
Unit - III	**Trees:**	**9**
Preliminaries – Binary Trees –Binary Tree Traversals- In order - Pre order - Post order - Search Tree ADT – Binary Search Trees– Insertion-Deletion Operations- Heaps.		
Unit - IV	**Graphs:**	**9**
Definitions – Elementary Graph Operations - Decrease and Conquer Algorithms -Topological Sort- Greedy Algorithms – Shortest-Path Algorithms – Single Source/All Destinations: Non-negative edge costs – Minimum Cost Spanning Tree – Prim„s Algorithm - Kruskal„s Algorithm.		
Unit - V	**Sorting:**	**9**
Preliminaries – Insertion Sort – Heapsort – Divide and Conquer Algorithms- Quick sort –Merge sort - Hashing – Static Hashing-Hash Tables- Hash function - Overflow handling.		

Total:45

TEXT BOOK:

1. Horowitz, Sahni, & Andreson Freed., " Fundamentals of Data Structures in C ", Universities Press, Hyderabad, 2011.

REFERENCES:

1. Weiss M. A., “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education Asia, New Delhi, 1997.
2. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	implement the different types of list and Summarize their operations	Applying (K3)
CO2	make use of ADTs like stacks, queues in different applications	Applying (K3)
CO3	construct trees and binary search trees and apply operations on	Applying (K3)
CO4	apply appropriate graph algorithms for solving computational problems	Applying (K3)
CO5	demonstrate various sorting and hashing techniques	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	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	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	15	20	65				100
CAT2	10	25	65				100
CAT3	10	25	65				100
ESE	10	25	65				100

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

18EIT41 - INDUSTRIAL INSTRUMENTATION I

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

Preamble	To learn the concepts, instruments used for the measurement of temperature, pressure, force, torque, velocity, acceleration and vibration	
Unit - I	**Mechanical Type Temperature Measurement:**	**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	**Electrical Type Temperature Measurement:**	**9**
Electrical Thermometers: Resistance Thermometers – Thermistors – Thermocouples – Radiation Pyrometers. Fiber -optic Temperature measurement systems – Ultrasonic Thermometers –Bolometer-Temperature switch.		
Unit - III	**Mechanical and Electrical Types of Pressure Measurement:**	**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	**Measurement of Vaccum Pressure and Calibration:**	**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	**Measurement of Force, Torque, Velocity, Acceleration, Vibration and Shock:**	**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 –Shock and Vibration measurement: Mechanical vibration sensors.		

Total:45

TEXT BOOK:

1. Krishnaswamy K., & Vijayachitra S., "Industrial Instrumentation", 2nd Edition, New Age International Publishers, New Delhi, 2014.

REFERENCES:

1. Ernest O. Doebelin & Dhanesh N. Manik, "Measurement Systems, Application and Design", 5th Edition, Tata McGraw Hill, New Delhi, 2008.
2. Singh S. K., "Industrial Instrumentation and Control", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	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	interpret the construction and working of vacuum measuring instruments	Understanding (K2)
CO5	express the usefulness of measuring parameters such as force, torque, velocity, acceleration, vibration and shock for various 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	1											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											2	2

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

ASSESSMENT PATTERN - THEORY

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

18EIT42 - ANALOG SIGNAL CONDITIONING IN INSTRUMENTATION

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

Preamble	To learn the Characteristics, Applications and design Signal Conditioning circuits with Opamp	
Unit - I	**Basics and Characteristics of OPAMP:**	**9**
Basics of operational amplifier -Ideal and practical characteristics of OpAmp – Block schematic of Operational amplifier. DC Characteristics: Input bias current-Input offset current-Input offset voltage -Thermal drift AC characteristics: Frequency response-Frequency Compensation methods- Slew Rate.		
Unit - II	**Applications of Operational Amplifier:**	**9**
Inverting, Non inverting, Voltage follower, Adder –Subtractor, Differentiator Integrator –Comparator. Wave generators: Astable and Monostable multivibrator -Schmitt trigger, RC phase shift oscillator, Precision diode. Active Filters: I order Low pass and High pass filters.		
Unit - III	**Data Converters:**	**9**
Characteristics: Resolution, 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. Sample and hold Circuit.		
Unit - IV	**Analog Signal Conditioning:**	**9**
Introduction- Analog Data Representation- Signal Level and Bias Changes, Linearization. Differential Instrumentation Amplifier -CMRR, Differential and Common Mode gain. Signal transmission: Current to Voltage converter. Analog Controllers: Proportional, Integral and Derivative mode Controllers.		
Unit - V	**Composite Controllers and Timers:**	**9**
Proportional Integral (PI), Proportional Derivative (PD), Proportional Integral Derivative (PID) controllers. Timers: IC555- Functional block diagram -Astable and monostable operation.		

Total:45

TEXT BOOK:

1. Roy Choudhry D., & Shail Jain, "Linear Integrated Circuits ", 4th Edition, New Age International publishers, New Delhi, 2014 for Units I,II,III,IV.
2. Curtis D. Johnson, "Process Control Instrumentation Technology ", 8th Edition, Pearson Education, London, 2016 for Unit V.

REFERENCES:

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw-Hill Pvt. Ltd., 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	develop analog signal conditioning circuits to convert an input range of voltages to desired output voltage	Applying (K3)
CO5	design analog circuits using composite controllers and Timers	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

18EIT43 - DC AND AC MACHINES

(Common to Electronics And Instrumentation Engineering & Mechatronics Engineering branches)

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**
Introduction : Classification of Electrical Machines– Static and Dynamic Induced EMF – Construction and Principle of Operation of DC machines – Types - EMF equation and Back EMF- Torque Equation, Characteristics of Series and Shunt motor – Starters : 3-Point starter – Speed Control: Armature and Field Control-Electric Braking-Applications.		
Unit - II	**Transformer and Synchronous Machines:**	**9**
Construction and Principle of Operation of single phase transformer-EMF equation- OC and SC test-Autotransformer. Alternator: Construction and Principle of Operation- EMF equation. Synchronous Motor: Construction and Principle of Operation - Starting Methods– Applications.		
Unit - III	**Induction Machines:**	**9**
Single phase Induction Motor: Construction and Principle of Operation-Types- Applications. Three phase Induction Motor: Construction and Principle of Operation- Torque Equation- Starters: DOL and Star/Delta Starter. Speed Control: Voltage, Frequency, V/f and Rotor Resistance Control– Applications.		
Unit - IV	**Stepper and Servo Motor:**	**9**
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation-Drive System-Logic Sequencer-Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.		
Unit - V	**Special Machines:**	**9**
Construction, Operation and Applications of: Brushless Permanent Magnet DC Motor Universal Motor– Switched Reluctance Motor-Submersible Bore Well Induction Motor.		

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. Theraja B.L., & Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2012.
2. Takashi Kenjo, "Stepping Motors and their Microprocessor Controls", 2nd Edition, Oxford University Press, USA, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss knowledge on construction and operation of DC and AC Machines	Understanding (K2)
CO2	assess the performance characteristics of machines through problem solving and conducting tests	Applying (K3)
CO3	implement starting and speed control techniques for different machines	Applying (K3)
CO4	compare and contrast various parameters of different electrical machines	Understanding (K2)
CO5	point out appropriate electrical machine 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	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	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)**

18CSL42 - DATA STRUCTURES AND ALGORITHMS LABORATORY

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	4	ES	0	0	2	1

Preamble	To practically impart the knowledge of algorithms and methods of data structures.

List of Exercises / Experiments :

1.	Implementation of C programs using pointers
2.	Implementation of singly linked list and its operations
3.	Implementation of doubly linked list and its operations
4.	Implementation of stack and its operations
5.	Convert a given infix expression to post-fix form and evaluate it using stack ADT
6.	Implementation of queue and its operations
7.	Implementation of binary search tree traversals
8.	Implementation of sorting algorithms: insertion sort, Heap sort
9.	Implementation of sorting algorithms:quick sort and merge sort
10.	Implementation of graph traversal techniques

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory manual
2.	GCC Compiler /Turbo C Compiler / Borland C C.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the appropriate data structure for a given problem	Applying(K3), Precision (S3)
CO2	apply data structures to practical applications	Applying(K3), Precision (S3)
CO3	synthesize operations like searching, sorting, insertion, deletion and traversing on various data structures	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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3

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

18EIL41 - 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 Opamp based circuits and signal conditioning for sensors and Transducers. And to Perform Simulation using CAD tools

List of Exercises / Experiments:

1.	Verification of Digital Basic Gate ICs and Implementation of Adder and Subtractor circuits.
2.	Verification of Flip-flops and Implementation of Shift Registers.
3.	Opamp application: Inverting, Non inverting Amplifier.
4.	Opamp application: Adder, Comparator.
5.	Design of Instrumentation Amplifier for various gain.
6.	Design of Signal conditioning Circuit for Strain gauge.
7.	Design of Signal conditioning Circuit for RTD.
8.	Design of Electronic PID controller.
9.	Design of 555 Timer in Astable and Monostable Mode of Operation.
10.	Simulation of Opamp based Circuits Anadigam and Implementation in FPAA.

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory manual
2.	Software: ANADIGM Tool

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design combinational and sequential circuits with digital ICs	Applying (K3), Precision (S3)
CO2	design linear, non linear and signal conditioning circuits using operational amplifier and perform simulation	Applying (K3), Precision (S3)
CO3	analyze with IC 555 timer for various duty cycles	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	1	1		1	3	3
CO2	3	2	1	1	1	2		1	1	1		1	3	3
CO3	3	3	2	2	2	2		1	1	1		1	3	3

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

18EIL42 - 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 and loops
2.	Programming with Structures, Local and Global Variables
3.	Programming with Arrays, Clusters and File I/O's
4.	Programming with Formula Node and Mathscript Tool
5.	Programming with State Machine
6.	Acquisition and Analysis of Electrical parameters using NI DAQ Card
7.	Acquisition and Analysis of Temperature using NI DAQ Card
8.	Acquisition and Analysis of Digital and Analog signals Using NI-ELVIS
9.	Acquisition and Analysis of Real Time Images using NI-EVS
10.	Sensor interfacing and Data acquisition using MyRio

Total:30

REFERENCES/MANUAL/SOFTWARE:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	execute LabVIEW programs using various controls and function palettes	Applying (K3), Precision (S3)
CO2	acquire and analyze real time signals using DAQ systems	Applying (K3), Precision (S3)
CO3	develop models to solve real time problems	Analyzing (K4), Precision (S3)

Mapping of COs with POs and PSOs

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

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

18EIT51 - CONTROL SYSTEMS

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	ES	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. Block diagram reduction using 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 System. Steady State Error and Error Constant –State Transition Matrix- time domain solutions of state models of second order systems with step input.		
Unit - III	**Stability Analysis in Time Domain:**	**9+3**
Concepts of Stability - Pole Locations and Stability - Routh Hurwitz Criterion - Root Locus Technique : conditions – angle and magnitude criterion – root locus construction –design of control loop gain.		
Unit - IV	**Frequency Response of Systems:**	**9+3**
Concept of Frequency Response, Frequency Response Analysis: Bode Plot and Polar Plot-gain margin and phase margin-deriving transfer function model from bode plot-Stability analysis in Frequency Domain: Nyquist Stability Criterion.		
Unit - V	**Compensators and Controllers in time domain:**	**9+3**
Effect of addition of poles and zeros on second order system response and system stability - Need for Compensator - Ideal Compensation on Time Response: P, PI, PD and PID controller - Design procedure of Lag and Lead Compensator via Root Locus.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

18EIT52 - MICROPROCESSOR AND MICROCONTROLLER

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

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

Total:45

TEXT BOOK:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi & Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 2nd Edition, Pearson Education, New Delhi, 2013 for Units II, III, IV, V.
2. Soumitra Kumar Mandal, "Microprocessors and Microcontrollers Architecture Programming and System Design 8085,8086 and 8051", 8th Edition, McGraw Hill Education (India) Pvt. Ltd, New Delhi, 2013 for Unit I.

REFERENCES:

1. Senthil Kumar N., Saravanan M., & Jeevananthan S., "Microprocessor and Microcontroller", 2nd Edition, Oxford University Press, New Delhi, 2016.
2. 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)**

18EIT53 - 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 theory course aims in imparting fundamental 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 – 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 – 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 – HydrostaticDensitometer – Ultrasonic and sonic densitometers – Radiation densitometers. Measurement of Viscosity: Capillary Viscometers – Efflux Cup Viscometers – Capillary Viscometer.		
Unit - V	**Humidity and Moisture:**	**9**
Measurement of Humidity: Dry and Wet bulb Psychrometers - Hair Hygrometers – Dew point Hygrometers - Electrolytic Hygrometers. Measurement of Moisture in Gases and Liquids:Piezoelectric Hygrometer - Infrared Absorption Hygrometer - Measurement of Moisture in Solids.		

Total:45

TEXT BOOK:

1. Krishnaswamy K., & Vijayachitra S., "Industrial Instrumentation", 2nd Edition, New Age International Publishers, New Delhi, 2014.

REFERENCES:

1. Singh S.K., "Industrial Instrumentation and Control", 3rd Edition, Tata McGraw Hill, New Delhi, 2009.
2. Patranabis D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.

	COURSE OUTCOMES: On completion of the course, the students will be able to	**BT Mapped (Highest Level)**
CO1	calculate 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 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			1		2		1	3	3
CO2	3	2	1	1	1			1		2		1	3	3
CO3	3	2	1	1	1			1		2		1	3	3
CO4	3	1						1		2		1	2	2
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	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)**

18EIT54 - DIGITAL SIGNAL PROCESSING

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

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

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Salivahanan S., "Digital Signal Processing", 3rd Edition, Tata McGraw Hill, New Delhi, 2013.

REFERENCES:

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson Prentice Hall, New Delhi, 2014.

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

Mapping of COs with POs and PSOs

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

18EIL51 - 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	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

18EIL52 - 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.	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.	Laboratory Manual
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

18EIL53 - 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) Venturitube c) Electro Magnetic flowmeters
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 calibration with HART Communicator
8.	Calibration of Temperature switches, Pressure switches and Safety Relief Valves
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	infer the conversion parameters and analyze their characteristics	Applying (K3), Precision (S3)
CO3	analyze the concentration and absorbance for various samples using suitable analyzer	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

18GEL51 - PROFESSIONAL SKILLS TRAINING I
(Common to all BE/ BTech / MSc /MCA /BSc Branches)

Programme & Branch	B.E. & Electronics and Instrumentation 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)**

18GET51 - UNIVERSAL HUMAN VALUES
(Common to all BE/BTech branches)

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	MC	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)**

18EIT61 - PROCESS CONTROL

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

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

Total:45

TEXT BOOK:

1.	Krishnaswamy K., "Process Control", 2nd Edition, New Age International (P) Ltd., Publishers, New Delhi,Reprint 2015 for Units I,III,IV,V.
2.	Wayne Bequette B, "Process Control: Modeling, Design, and Simulation", 2nd Edition, Prentice Hall of India, New Delhi, 2013 for Unit II.

REFERENCES:

1.	Surekha Bhanot, "Process Control: Principles and Applications", 4th Edition, Oxford University Press, United Kingdom, 2017.
2.	Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar & Francis J. Doyle, "Process Dynamics and Control", 4th Edition, John Wiley and Sons, USA, 2016.
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)**

18EIT62 - LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Logic Design	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) - Program scan – PLC programming languages – Relay type instructions – Instruction addressing – Internal relay instructions – Entering the ladder diagram.		
Unit - II	**PLC Programming:**	**9**
Programming timers: On delay timer instruction – Off delay timer instruction – Retentive timers - Programming counters: Counter instructions – Up counter – Down counter – Cascading counters – Combining counter and timer functions - Program control instructions: Master control reset instruction – Jump instruction and subroutines. 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 - Water and waste water treatment plants - Cement plants – Pulp and Paper plants – Introduction to SCADA.		

Total:45

TEXT BOOK:

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

REFERENCES:

1. Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co., Canada, 2019.
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)**

18EIT63 - EMBEDDED SYSTEMS

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

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18EIL61 - PROCESS CONTROL LABORATORY

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

18EIL62 - LOGIC AND DISTRIBUTED CONTROL SYSTEMS LABORATORY

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Control Systems	6	PC	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, SCADA and DCS applications with discrete I/Os.
2.	PLC, SCADA and DCS applications with analog I/Os.
3.	Stepper motor, conveyor and pneumatic control systems using PLC
4.	Electrical and pneumatic actuator control using DCS
5.	Level Control in Cylindrical, Conical and Spherical tank systems using PLC
6.	Level Control in Cylindrical, Conical and Spherical tank systems using DCS
7.	Level Control in Cylindrical tank with FB, FF control systems using DCS
8.	Level Control in Cylindrical tank with ratio and Cascade control systems using DCS
9.	3 Phase motor and Submersible pump control using VFD, PLC and HMI/ SCADA
10.	3 Phase motor and Submersible pump control using VFD and DCS

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

18EIL63 - 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.	Design and Simulation of Combinational and Sequential Circuits
7.	Implementation of MAC, ALU in FPGA using Xilinx/ Altera
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

18GEL61 PROFESSIONAL SKILLS TRAINING II
(Common to all BE/ BTech / MSc /MCA /BSc Branches)

Programme & Branch	B.E. & Electronics and Instrumentation 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.		

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				3	3		3		3	2	3	3
CO2	3	2				3	3		3		3	2	3	3
CO3		2				3	3		3	3	3	2	3	3

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

ASSESSMENT PATTERN - THEORY

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

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

18EIP61 - PROJECT WORK I PHASE I

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	EC	0	0	4	2

Total: 60

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

Mapping of COs with POs and PSOs

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

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

18MBT71 - ENGINEERING ECONOMICS AND MANAGEMENT

(Common to All Engineering And Technology Branches except Chemical Engineering)

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

Preamble	The aim of the course is to create fundamental knowledge on management by introducing concepts like economics, national income, marketing, operations management, accounting principles etc.	
Unit - I	**Micro Economics:**	**9**
Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.		
Unit - II	**Macro Economics, Business Ownership and Management concepts:**	**9**
National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Ownership types. Management concepts: Taylor and Fayol's Principles – Functions of Management - Managerial Skills - Levels of Management - Roles of manager.		
Unit - III	**Marketing Management:**	**9**
Marketing - Core Concepts of Marketing - Four P's of Marketing - New product development – Intellectual Property rights (IPR), Product Life Cycle - Pricing Strategies and Decisions.		
Unit - IV	**Operations Management:**	**9**
Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.		
Unit - V	**Financial Management:**	**9**
Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Significance –Traditional and discounted cash flow methods.		

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEP71 – COMPREHENSIVE TEST AND VIVA
(Common to all BE/BTech branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	EC	0	0	0	2

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

Mapping of COs with POs and PSOs

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

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

.18EIP71 - PROJECT WORK I PHASE II

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	EC	0	0	8	4

Total: 120

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

Mapping of COs with POs and PSOs

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

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

18EIP81 - PROJECT WORK II

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	EC	0	0	12	6

Total: 180

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

Mapping of COs with POs and PSOs

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

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

18EIE01 - BIOMEDICAL INSTRUMENTATION

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Transducers Engineering	6	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 Defibrillator- Heart lung machine - Kidney machine - Audiometer - Biothesiometry Vibroscreen - Ophthalmoscope –Biotelemetry - Telemedicine.		

Total:45

TEXT BOOK:

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

REFERENCES:

1. John G. Webster, "Medical Instrumentation Application and Design", 4th Edition, John Wiley and Sons, New York, 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)**

18EIE02 - VLSI DESIGN

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

Preamble	To impart global understanding of Verilog Hardware Description Language and MOS transistor characteristics, fabrication and testing of ICs.	
Unit - I	**Verilog HDL- Gate Level modeling and Data flow modeling:**	**9**
Overview of Verilog HDL- Hierarchical Modeling Concepts-Basic Concepts- Modules and Ports- Gate level modeling- Dataflow modeling.		
Unit - II	**Verilog HDL- Behavioural modeling and Switch level modeling:**	**9**
Behavioral modeling – Structured Procedures- Blocking and non-blocking statements- delay control- event control, conditional statement- multiway branching-loop- Switch level modeling - Tasks and Function- RTL Coding.		
Unit - III	**MOS Transistor:**	**9**
CMOS Logic- MOS Transistor Theory- Long Channel I-V characteristics- C-V characteristics- Non ideal I-V effects- DC characteristics--Power dissipation – Switching Characteristics.		
Unit - IV	**MOS Fabrication:**	**9**
An overview of silicon semiconductor technology - Basic CMOS technology: Nwell- P well, Twin tub and SOI Process- Latch up and prevention- Layout Design rules- Stick diagram- Layout diagram for basic logic gates- Introduction to Static CMOS- Pseudo nMOS logic -Dynamic CMOS.		
Unit - V	**CMOS Testing:**	**9**
Need for testing- Manufacturing test principles- Design strategies for test- chip level test techniques-system level test techniques.		

Total:45

TEXT BOOK:

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

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	learn Verilog Hardware Description Language Programming	Applying (K3)
CO2	model VLSI systems using Verilog Hardware Description Language	Applying (K3)
CO3	examine the characteristics of MOS transistor	Understanding (K2)
CO4	describe the techniques used for VLSI fabrication, layout design rules and draw layout of logic functions	Applying (K3)
CO5	compare the techniques for chip level and system level testing	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	1								1			2	2
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		10	90				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)**

18EIE03 - SOFT COMPUTING TECHNIQUES

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

Preamble	Soft Computing is a compilation of computational techniques in computer science, artificial intelligence and engineering disciplines which attempt to study, model and analyze complex problems for which conventional methods were not able to produce low cost and complete solutions. 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.		
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 – Fuzzifiction – 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.		
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). Application of Neural Networks: Pattern Classification – Application of Fuzzy logic Controller.		

Total:45

TEXT BOOK:

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

REFERENCES:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Wiley, New Delhi, 2010.
2. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", 2nd Edition, Pearson Education, London, 2001.
3. Jang J.S.R., Sun C.T., & Mizutani E., "Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence", 1st Edition, Prentice Hall, United States, 1997.

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	45	45				100
ESE	20	30	50				100

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

18EIE04 - PIPING AND INSTRUMENTATION DIAGRAMS

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	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,Standards and Identification Systems:**	**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 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, Pipes and Equipments:**	**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. 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	**Application of Control Architectures:**	**9**
Control System Design – Building a control loop – Multi loop control Architectures: Cascade control – Feedforward plus feedback control: Ratio or Relationship Control - Selective Control - Override and Limit Control - Split Range and Parallel Control. Applications of P&ID: Computer Aided Drawing.		

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.

REFERENCES:

1. Moe Toghraei, “Piping and Instrumentation Diagram Development”, 1st Edition, Wiley-Blackwell, USA, 2019.
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	construct Multi loop control architectures and develop computer aided Piping & Instrumentation Diagram for simple control 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						1		2			2	2
CO2	3	1						1		2			2	2
CO3	3	2	1	1	1			1		2			2	2
CO4	3	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	40	60					100
CAT3	20	30	50				100
ESE	20	40	40				100

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

18EIE05 - INDUSTRIAL ELECTRONICS AND DRIVES

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	DC and AC Machines	6	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 semiconverters – Inverting mode of a converter - Effect of source and load inductances.		
Unit - III	**DC to DC Converters (Choppers):**	**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.		
Unit - IV	**DC drives and Introduction to AC drives:**	**9**
Basic characteristics of DC motors – Operating modes – Single phase semiconverter 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 plants – Cranes and Hoist Drives – Cement plant – Sugar plant- Paper plant.		

Total: 45

TEXT BOOK:

1. Rashid M.H., "Power Electronics – Circuits, Devices and Applications", 4th Edition, Pearson Education, New Delhi, 2014.

REFERENCES:

1. Vedam Subrahmanyam, "Electric Drives-Concepts and Applications", 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2017.
2. Moorthi V.R., "Power Electronics - Devices, Circuits and Industrial Applications", 1st Edition, Oxford university press, New Delhi, 2012.
3. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi,Reprint 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)**

18EIE06 - ADVANCED CONTROL THEORY

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

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

Total: 45

TEXT BOOK:

1. Gopal M., "Digital Control and State Variable Methods", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.

REFERENCES:

1. Slotine & Li., "Applied Nonlinear Control", 2nd Edition, Prentice Hall Publishers, USA, 1991.
2. Richard C. Dorf & Robert H. Bishop, "Modern Control Systems", 12th Edition, Pearson Publication, New Jercy, 2013.
3. Khalil & Hasan K, "Nonlinear Systems", 2nd Edition, Prentice Hall, New Jercy, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyse the time domain characteristics of continuous 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	2	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)**

18EIE07 - 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 - Atomic Absorption Instrumentation.		
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**
Blood Gas analyzer: Measurement of Blood pCO2 and Blood pO2 Measurement. Air Pollution Monitoring Instruments: CO analyzer, SO2 analyzer, Ozone analyzer. Water Pollution Monitoring Instruments: Dissolved oxygen, oxidation-reduction potential, Turbidity meter.		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Ewing G.W., "Instrumental Methods of Chemical Analysis", 6th Edition, McGraw-Hill, New York, 2007.
2. Douglas A. Skoog, James Holler F & Stanley R. Crouh, "Principles of Instrumental Analysis", 6th Edition, 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							3	3
CO5	3	2	1	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	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)**

18EIE08 - 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- Generalised 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 Impedence meter-Rx meters-Automatic Bridges.		
Unit - III	**Signal Generators:**	**9**
Introduction – Fixed Frequency AF Oscillator– Variable AF Oscillator - Basic Standard Signal Generator (Sine Wave)– Modern Laboratory Signal Generator - AF Sine and Square Wave Generator – Function Generator– Square and Pulse Generator (Laboratory Type)- Random Noise Generator- Sweep Generator.		
Unit - IV	**Display Devices:**	**9**
Displays-Classification-LED & LCD-LCOS-Bar graph display-Segmental and Dot matrix display-Plasma Display-OLED-FOLED-simple CRO.		
Unit - V	**Instrument Calibration:**	**9**
Introduction-Comparison methods-Digital multimeters as standard Instruments-Calibration instruments-Potentiometers-Potentiometer calibration methods-Multifunction calibrators-Multiproduct calibrators-Automated calibration.		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. David A. Bell, "Electronic Instrumentation and Measurements", 3rd Edition, Oxford University Press, New Delhi, 2013.
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)**

18EIE09 - 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.		
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.		

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 & Richard E. Woods, "Digital Image Processing", 4th Edition, Pearson, 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)**

18EIE10 - 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 and Turbine Monitoring:**	**9**
Master control – Boiler Efficiency – Maintenance of Measuring Instruments – Interlocks for Boiler operation – Application of Distributed control system in Power Plants. Turbine Steam inlet system – Turbine Measurements: Process parameters – Turbine control system: Safety control systems - Process control systems –Lubrication for Turbo-Alternator - Turbo-Alternator Cooling System.		
Unit - V	**Instrumentation and Control in Nuclear Power Plant:**	**9**
Nuclear Power Plant components - Sensors and measurement system - Digital architectures in nuclear power plants – Reactor control: Pressurized Water Reactor (PWR) – Boiler Water Reactor (BWR) - Fast breeder reactor (FBR) - Radiation protection and monitoring – Nuclear reactor safety: Case study.		

Total: 45

TEXT BOOK:

1. Krishnaswamy K., & Ponni Bala 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 ", 1st Edition, Academic Press Publications, United States, 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			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	40	60					100
CAT2	40	60					100
CAT3	10	40	50				100
ESE	20	40	40				100

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

18EIE11 - WIRELESS INSTRUMENTATION

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

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

Total: 45

TEXT BOOK:

1. John G. Webster, & Halit Eren, "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)**

18EIE12 - 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- Optimisation method-Pole placement method.		
Unit - II	**Controller architecture and Controller tuning rules:**	**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 and Mutivariable tuning methods:**	**9**
PID tuning based on gain and phase margins-MIMO loop gain margins. Mutivariable tuning methods: Classification – parametric methods -non parametric methods- robustness measures-robust based PID design – sensitivity function-robust PID tuning rules.		
Unit - V	**Modern PID Control :**	**9**
Characterization of all stabilizing PID controllers-Direct PID synthesis from frequency response data-Data based design Vs model based design- Event based PID control -Classifications- Data driven PID control- Industrial applications of PID control -Challenges and solutions-Chemical reactor-Distillation column-Evaporator.		

Total: 45

TEXT BOOK:

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

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	3	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)**

18EIE13 - 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.		

Total: 45

TEXT BOOK:

1. Thyagarajan K., & Ajoy Ghatak, "Lasers: Fundamentals and Applications", 2nd Edition, Springer Science & Business Media, New York, 2011 for Units III, IV.
2. John M. Senior, “Optical Fibre Communications – Principles and Practice”,3rd Edition, Pearson Education India, New Delhi, 2010 for Units I.

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 Interactions: Fundamentals and Applications", 4th Edition,Springer Science & 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)**

18EIE14 - 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 Wearable 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, Social Impact and Health Issues:**	**9**
Psychological effects of wearables – Social implications – Technology acceptance factors – Electromagnetic radiations – Specific absorption rate – Thermal effects. **Health Issues:** Cancers – Fertility – Vision and sleep disorder – Pain and discomfort – Electromagnetic intolerance and other risks.		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Raymond Kai-Yu Tong, “Wearable Technology in Medicine and Health Care”, Academic Press, United States,2018.
2. Fernando Jose Velez & Fardin Derogarian Miyandoab, “Wearable Technologies and Wireless Body Sensor Networks for Healthcare” 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)**

18EIE15 - DEEP NEURAL NETWORKS FOR COMPUTATIONAL IMAGING

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

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

Total: 45

TEXT BOOK:

1. Josh Patterson, & Adam Gibson, "Deep Learning, A Practioner's Approach", 1st Edition, O'Reilley Media,Inc, USA, 2017.

REFERENCES:

1. Sridhar S., "Digital Image Processing", 4th impression Edition, Oxford University Press, New Delhi, 2013.
2. Ian Godfellow, Yoshua Bengio, & Aaron Courvillie, "Deep Learning", 2nd Edition, The MIT Press, Cambridge Massachusetts, 2016.
3. Gonzales R. C., Woods R. E., & Eddins S. L., "Digital Image Processing using MATLAB", 1st Edition, Pearson Prentice Hall, Newyork, 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)**

18EIE16 - INSTRUMENTATION TECHNIQUES IN AGRICULTURE

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

1. 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 Transducers 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)**

18EIE17 - INDUSTRIAL INTERNET OF THINGS

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

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

18EIE18 - OPTIMAL AND ADAPTIVE CONTROL

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

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

Total: 45

TEXT BOOK:

1. Kirk, Donald E., "Optimal Control Theory: An Introduction", 1st Edition, Dover publications, USA, 2004 for Units I,II,III.
2. Karl J. Astrom, & Bjorn Wittenmark, "Adaptive Control", 2nd Edition, Addison Wesley, USA, 1995 for Units IV,V.

REFERENCES:

1. Desineni Subburam Naidu, "Optimal Control Systems", 1st Edition, CRC Press, London, 2002.
2. Rolf Isermann, & 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	Understanding (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	Understanding (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)**

18EIE31 - 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 - Barriers to TQM Implementation.		
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 - Performance Measures		
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 - Process - case studies.		
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 - Barriers in TQM implementation.		

Total: 45

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the need, history and principles of quality and TQM	Applying (K3)
CO2	illustrate the principles and strategies of TQM	Applying (K3)
CO3	make use of various tools and techniques of quality management	Analyzing (K4)
CO4	apply various quality tools and techniques in both manufacturing and service industry	Applying (K3)
CO5	explain the concepts of quality management system and ISO.	Applying (K3)

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

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	45	30				100
CAT2	20	30	30	20			100
CAT3	25	45	30				100
ESE	20	30	35	15			100

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

18EIE19 - 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 and Toxicology:**	**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 and Prevention:**	**9**
Fires and Explosions: The Fire Triangle – Distinction between Fires and Explosions – Flammability Characteristics of Liquids and Vapors – Sprays and Mists – Ignition Energy – Ignition Sources. Explosions: Detonation and Deflagration - Confined Explosions Concepts to Prevent Fires and Explosions: Inerting: Vacuum Purging, Pressure Purging. Explosion-Proof Equipment and Instruments – Ventilation – Sprinkler Systems.		
Unit - III	**Hazards Identification and Evaluation:**	**9**
Introduction to Hazard Identification/ Evaluation and Risk Analysis – Non-Scenario-Based Hazard Identification/Evaluation Methods – Scenario-Based Hazard Identification/ Evaluation Methods – Documentation and Actions Required for Hazard Identification and Evaluation.		
Unit - IV	**Risk Analysis and Assessment:**	**9**
Review of Probability Theory – Event Trees– Fault Trees – Bow-Tie Diagrams– Quantitative Risk Analysis– Layer of Protection Analysis – Risk Assessment.		
Unit - V	**Safety Strategies, Procedures, and Designs:**	**9**
Process Safety Strategies – Safe Operating Procedures – Safe Work Practices – Designs for Process Safety – Designs for Runaway Reactions– Designs and Practices for the Safe Handling of Dusts.		

Total: 45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18EIE20 - 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	**Nano Materials and Nano properties:**	**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	**Nanoscale Characterization and Nanofabrication:**	**9**
Scanning Tunneling Microscopy – AFM – Scanning Electron Microscopy– TEM. General Principles of Nano Fabrication – Fluid Flow in Submicrometer and Nanoscales – Heat Conduction at Nanoscale – Measurement of Thermal Conductivity– Nano Products – Application of Nanoproducts – Challenges in Nanoscale Engineering**.**		

Total: 45

TEXT BOOK:

1. Tai-Ran Hsu, "MEMS and Microsystems: Design, Manufacture and Nano Scale Engineering", 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)**

18EIE21 - 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 to Probability – Classification - Losses and Risks – Discriminant Function.		
Unit - II	**Parametric Methods and Decision Learning:**	**9**
Maximum Likelihood Estimation – The Bayes Estimator – Parametric Classification. Multivariate Methods: Parameter Estimation – Multivariate Classification. 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 – Dimensionality Reduction – Learning Time: Time Delay Neural Networks – Recurrent Networks.		
Unit - IV	**Local and Graphical Models:**	**9**
Local Models:Introduction – Competitive Learning – Radial Basis Functions – 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: Finding related posts – Regression: Predicting house prices with regression. Classification: Music Genre Classification – Computer vision – Pattern Recognition.		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Luis Pedro Coelho, & Willi Richert, "Building Machine Learning Systems with Python", 2nd Edition, Packt Publishing, England, 2015.
2. Tom M. Mitchelll, "Machine Learning", 1st Edition, McGraw-Hill Education, New York, 1997.
3. James A. Anderson, "An Introduction to Neural Networks", 1st Edition, MIT Press, United Kingdom, 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 parametric methods and decision learning	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)**

18EIE22 - INSTRUMENTATION IN AIRCRAFT NAVIGATION AND CONTROL

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

18EIE23 - INDUSTRIAL DATA COMMUNICATION

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	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:**	**9**
Copper cable: 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:**	**9**
Modbus: 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:**	**9**
HART: HART Introduction – HART and smart instrumentation – Physical layer, Data link and application layer - HART Commands – HART protocol problems. Foundation Field Bus: Introduction - The Physical layer and Wiring Rules– The Data link layer– The Application layer– The User layer– Error detection and diagnostics - High-speed Ethernet (HSE).		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Wayne Tomasi, “Electronic Communication Systems: Fundamentals through Advanced”, 5th Edition Pearson Education, New Delhi, 2013.
2. Ian Verhappen, & Augusto Pereira, “Foundation Fieldbus, 4th Edition” International Society of Automation, 2012.
3. Forouzan Behrouz A., “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)**

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18EIE24 - COMPUTER CONTROL OF PROCESSES

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

Total: 45

TEXT BOOK:

1. Karl Astrom J., & Jorn Wittenmark.B., "Computer Controlled Systems:Theory and Design ", 3rd Edition, Prentice Hall Publishers, China, 1997 for Units I,II,IV.
2. Babatunte A, Ogunnaike W., & Harmon Ray, "Process Dynamics Modeling and Control ", 1st Edition, Public Oxford University Press, Newyork, 1994 for Units III,V.

REFERENCES:

1. Singh S.K., "Computer aided process control", 1st Edition, Prentice Hall Publishers, 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, 2014.

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	Analyzing (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)**

18GEE01 - FUNDAMENTALS OF RESEARCH

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course familiarize the fundamental concepts/techniques adopted in research, problem formulation and also disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.	
Unit - I	**Introduction to Research**	**9**
Introduction to Research: Types and Process of Research - Outcome of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords.		
Unit - II	**Literature Review**	**9**
Literature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.		
Unit - III	**Research Methodology**	**9**
Research Methodology: Appropriate Choice of Algorithms/Methodologies/Methods - Measurement and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations.		
Unit - IV	**Journals and Papers:**	**9**
Journals and Papers: Journals in Science/Engineering - Indexing and Impact factor of Journals. Plagiarism and Research Ethics. Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study.		
Unit - V	**Reports and Presentations**	**9**
Reports and Presentations: How to Write a Report - Language and Style - Format of Project Report - Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc - Different Reference Formats. Presentation using PPTs. Research Tools.		

Total: 45

TEXT BOOK:

1. Walliman, Nicholas. “Research Methods: The basics”. Routledge, 2017.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	list the various stages in research and categorize the quality of journals.	Analyzing (K4)
CO2	formulate a research problem from published literature/journal papers	Evaluating (K5)
CO3	write, present a journal paper/ project report in proper format	Creating (K6)
CO4	select suitable journal and submit a research paper.	Applying (K3)
CO5	compile a research report and the presentation	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18MBE49 - ENTREPRENEURSHIP DEVELOPMENT

(Common to All BE/BTech Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Engineering Economics and Management	8	EC	3	0	0	3

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur	Applying (K3)
CO2	identify suitable entrepreneurial ventures and business opportunity	Applying (K3)
CO3	assess the components of business plan	Analyzing (K4)
CO4	appraise the sources of finance and interpret accounting statements	Applying (K3)
CO5	interpret the causes of sickness of small scale enterprises and its remedies	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18EIE25 - MULTI SENSOR DATA FUSION

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

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

Total: 45

TEXT BOOK:

1. Martin E. Liggins, David L. Hall & James Llinas, "Handbook of Multisensor Data Fusion: Theory and Practice", 2nd Edition, CRC Press, Boca Raton, 2009 for Units I, II and III.
2. David L. Hall, Sonya A.H & McMullen, "Mathematical techniques in Multisensor data fusion", 2nd Edition, Artech House, Boston, 2004 for Units IV and V.

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)**

18EIE26 - 3D PRINTING HARDWARE

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publications, 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)**

18EIE27 - ARTIFICIAL INTELLIGENCE

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the concept of artificial intelligence and impart knowledge on the fundamental concept of intelligent system	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 involved 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											3	3
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)**

18EIE28 - INSTRUMENTATION AND CONTROL IN PROCESS INDUSTRIES

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

Preamble	This course provides the concepts of various processes in process Industries such as petrochemical, paper, steel, dairy products, pharmaceutical and fermentation. This course emphasizes the Instrumentation and Control techniques involved in such units.	
Unit - I	**Instrumentation and control in Petrochemical Industries:**	**9**
Petroleum Exploration – Composition of Petroleum – Drilling – Recovery techniques – Crude oil distillation – Refining of crude oil – Thermal Cracking – Catalytic cracking –Split range controls with multiple coolants – Evaporator cascade control - Distillation Column control.		
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).		
Unit - V	**Instrumentation and control in Pharmaceutical and Fermentation Industries:**	**9**
Description of the penicillin production process – flow measurement – Level measurement – Pressure measurement – Temperature measurement – Fermentation control system – Continuous fermentation – pH control – Temperature control – Centrifuge purging control.		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Robert A. Meyers, "Handbook of Petroleum Refining Processes", 3rd Edition, Tata McGraw-Hill, Newyork, 2003.
2. Gosta Bylund, "Dairy processing hand book", 1st Edition, Tetrapak processing systems, Sweden, 1995.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the various instrumentation and controls involved in petrochemical industry	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)**

18EIE29 - INTELLIGENT ROBOTIC SYSTEMS

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

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

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

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

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

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

18EIE30 - CONTROL SYSTEM COMPONENTS

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 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:**	**9**
Servomotors: Theory of operation and transfer function of DC servomotors and AC servomotors. Stepper motor: Types – Construction and working – Driver circuits – Applications. Tachogenerators: Characteristic requirements – EMF equation - Commutation and armature reaction problem- AC induction tachogenerators-Working - Sources of errors- Applications.		
Unit - IV	**Amplifiers and Modulators:**	**9**
Rotating amplifiers: Types – Amplidyne generator- Working principle –Transfer function. Magnetic amplifiers: Series connected - Parallel connected- Magnetic amplifiers with feedback. Servo amplifiers: Features – AC and DC servo amplifiers - Performance characteristics. Modulators and demodulators: Amplitude modulation theory- Half and full wave balanced modulator- Amplitude modulator circuit.		
Unit - V	**Hydraulic systems:**	**9**
Components – Classifications- Hydraulic pumps - Hydraulic transmission lines- Hydraulic power supply. Hydraulic valves: Spool type- Nozzle valve- Flapper valve- Pulsed operation of control valves. Pneumatic systems: Pneumatic power supply – Compressor efficiency - Accessories for air compressor- Flow control. Pneumatic control valves: Operating mechanism – Direction control valves-P,PI and PID pneumatic control valves.		

Total: 45

TEXT BOOK:

1. Desai M.D., "Control System Components", 1st Edition, PHI learning Pvt Ltd, New Delhi, 2008.

REFERENCES:

1. Gibson J.E., & Tuteur F.B., "Control System Components", 1st Edition, Tata 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", 4th Edition, 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	understand 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)**

18EIO01 - NEURAL NETWORKS AND DEEP LEARNING
(Offered by Department of Electronics and Instrumentation Engineering)

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

Preamble	Several neural network approaches had been explored in order to advance the performance of many state-of-the-art visual recognition problems such as image searching, understanding, medical applications, autonomous vehicles such as drones and self-driving cars etc. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks.	
Unit - I	**A Review of Machine Learning:**	**9+3**
The Learning Machines – The Math behind Machine Learning: Linear Algebra and Statistics – Regression – Classification – Clustering – Underfitting and Overfitting – Logistic Regression – Evaluating models – Building an Understanding of Machine Learning.		
Unit - II	**Foundations of Neural Networks and Deep Learning:**	**9+3**
Artificial Neural networks: Characteristics of biological and Artificial neural networks. Supervised learning Network: Perceptron and Back Propagation Network. Fundamentals of Deep Networks: Definition – Common Architectural Principles of Deep Networks – Building Blocks of Deep Networks.		
Unit - III	**Convolutional Neural Networks:**	**9+3**
Convolution Operation - Motivation - Pooling – Convolution and Pooling as an Infinitely strong Prior - Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Random or Unsupervised Features – The Neuroscientific Basis for Convolutional Networks.		
Unit - IV	**Sequence Modeling and Auto Encoders:**	**9+3**
Unfolding Computational graphs – Recurrent Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Recursive Neural Networks – The Challenge of Long Term Dependencies. Autoencoders: Undercomplete and Regularized Autoencoders – Denoising Autoencoders		
Unit - V	**Applications of Deep Learning:**	**9+3**
Solving Logic functions using neural network – Building a Deep Learning neural network: Image Classification and Regression using CNN - Text Recognition using RNN – Using Autoencoders for Anomaly Detection.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Josh Patterson & Adam Gibson, "Deep Learning, A Practioner's Approach", 1st Edition, O'Reilley Media, USA, 2017 for Units I,II,III.
2. Ian Godfellow, Yoshua Bengio & Aaron Courvillie, "Deep Learning", 2nd Edition, The MIT Press, Cambridge Massachusetts, Cambridge, 2016 for Units IV, V.

REFERENCES:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", 2nd Edition, Pearson Education, New Delhi, 2001.
2. Sivanandam S.N., & Deepa S.N., "Principles of Soft Computing", Wiley, India, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the basic mathematics and statistics in machine learning	Applying (K3)
CO2	explain the basic concepts of neural networks and deep learning algorithms	Understanding (K2)
CO3	analyze the impact over convolutional neural networks with classification problems	Applying (K3)
CO4	interpret the need of using sequence modeling and autoencoders	Understanding (K2)
CO5	apply deep learning algorithms for various 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	2	1	1	1								3	3
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	30	50				100
CAT2	20	40	40				100
CAT3	25	40	35				100
ESE	20	45	35				100

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

18EIO02 - DIGITAL IMAGE PROCESSING AND ITS APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

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

Lectur:45, Tutorial:15, Total :60

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	44	36				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

18EIO03 - INDUSTRIAL AUTOMATION
(Offered by Department of Electronics and Instrumentation Engineering

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

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

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18EIO04 - BIOMEDICAL INSTRUMENTATION AND APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	28	28	44				100
CAT2	12	24	64				100
CAT3	24	32	44				100
ESE	24	32	44				100

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

18EIO05 - PLC PROGRAMMING AND ITS APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18EIO06 - MEASUREMENTS AND INSTRUMENTATION
(Offered by Department of Electronics and Instrumentation Engineering)

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

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18EIO07 - GRAPHICAL PROGRAMMING USING VIRTUAL INSTRUMENTATION
(Offered by Department of Electronics and Instrumentation Engineering)

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

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18MAO01 - MATHEMATICAL FOUNDATIONS OF MACHINE LEARNING

(Offered by Department of Mathematics)

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

Preamble	To impart the basic knowledge in linear algebra, decomposition of matrices, continuous optimization, linear regression and support vector machines which provide the foundations for machine learning and deep learning.	
Unit - I	**Vector Spaces:**	**9+3**
Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity		
Unit - II	**Linear Transformations:**	**9+3**
Introduction – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - III	**Inner Product Spaces:**	**9+3**
Norms – Inner products – Length and Distance – Angle and Orthogonality – Orthonormal Basis – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Rotations.		
Unit - IV	**Matrix Decomposition And Continuous Optimization:**	**9+3**
Cholesky decomposition – Singular Value Decomposition, Continuous Optimization: Introduction – Unconstrained Optimization – Gradient Descent method – Constrained Optimization – Lagrange Multipliers method – Convex Optimization		
Unit - V	**Linear Regression And Support Vector Machines:**	**9+3**
Parameter Estimation – Maximum Likelihood estimation – Bayesian linear regression – Bayesian parameter estimation of Gaussian distribution, Support Vector Machines: Introduction – Margin and support vectors – Kernels – Primal support vector machine – Dual support vector machine.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 9th Edition, John Wiley and Sons, New Delhi, 2011 for Units I, II, III.
2. Deisenroth M.P., Faisal A.A. and Ong C.S., "Mathematics for Machine Learning", 1st Edition, Cambridge University Press, 2019 for Units IV, V.

REFERENCES:

1. David C. Lay, Steven R. Lay and Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2. Ethem Alpaydin, "Introduction to Machine Learning(Adaptive Computation and Machine Learning series)", 4th Edition, MIT Press, USA, 2020.
3. Duda R.O., Hart E. and Stork D.G., "Pattern Classification", 2nd Edition, John Wiley and Sons, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of vector spaces.	Understanding (K2)
CO2	apply the concepts of linear mappings in machine learning.	Applying (K3)
CO3	use the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Applying (K3)
CO4	apply the knowledge of factorisation of matrices and optimization techniques in clustering and classification of data.	Applying (K3)
CO5	describe the concepts of parameter estimation and support vector machine.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	50	40				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	5	25	70				100

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

18MAO02 - GRAPH THEORY AND ITS APPLICATIONS

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

Preamble	To develop rigorous logical thinking and analytical skills by graph theoretic concepts which helps for solving real time engineering problems in networks, computer architecture, compiling techniques, model checking, artificial intelligence, software engineering, expert systems, software/hardware correctness problem.	
Unit - I	**Graphs:**	**9+3**
Introduction – Definition – Types of graphs – Degree of vertex – Walk, path and cycle – Isomorphism – Connected graph – Hamiltonian graph – Euler graph – Digraph – Representations of graphs: Adjacency matrix – Incidence matrix.		
Unit - II	**Trees:**	**9+3**
Introduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – Spanning tree – Construction of spanning tree: BFS algorithm – DFS algorithm – Tree traversal.		
Unit - III	**Graph Coloring:**	**9+3**
Vertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching – Covering – Four color problem (statement only) – Simple applications.		
Unit - IV	**Basic Algorithms:**	**9+3**
Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm – Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Krushkal's algorithm – Optimal assignment – Kuhn and Munkres algorithm – Travelling salesman problem: Two optimal algorithm – Closest Insertion Algorithm.		
Unit - V	**Network Flows and Applications:**	**9+3**
Flows and cuts in networks - Max-flow Min-cut Theorem – Algorithms: Flow Augmenting Path – Ford-Fulkerson Algorithm for Maximum Flow – Edmonds and Karp algorithm.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, New Delhi, 2010.

REFERENCES:

1. Douglas B.West, "Graph Theory", 2nd Edition, Prentice Hall, New Delhi, 2017.
2. Jonathan L. Gross & Jay Yellen, "Graph Theory and its Applications", 2nd Edition, CRC Press, New York, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the types of graphs and illustrate isomorphism on graphs.	Understanding (K2)
CO2	use the concepts and properties of different types of trees in data structures.	Applying (K3)
CO3	estimate the chromatic partition, chromatic polynomial and matching of a given graph.	Applying (K3)
CO4	apply various graph theoretic algorithms to communication and network problems.	Applying (K3)
CO5	identify the maximal flow in network by means of algorithms.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18MAO03 - NUMBER THEORY AND CRYPTOGRAPHY

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

Preamble	To provide the skills for applying various number theoretic algorithms, congruences, primality tests in cryptography and network security and impart knowledge of basic cryptographic techniques.	
Unit - I	**Divisibility Theory and Canonical Decompositions:**	**9+3**
Division algorithm- Base-b representations – number patterns – Prime and composite numbers – Fibonacci and Lucas numbers – Fermat numbers – GCD – Euclidean Algorithm – Fundamental theorem of Arithmetic – LCM.		
Unit - II	**Theory of Congruences:**	**9+3**
Basic concepts – Properties of congruences – Linear congruences – Solution of congruences – Fermat's Little theorem – Euler's theorem – Chinese remainder theorem.		
Unit - III	**Number Theoretic Functions:**	**9+3**
Introduction – Functions τ and σ– Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.		
Unit - IV	**Primality Testing and Factorization:**	**9+3**
Primality testing: Fermat's pseudo primality test – Solvay-Strassen test – Miller-Rabin test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard's Rho method – Quadratic sieve method.		
Unit - V	**Classical Cryptographic Techniques:**	**9+3**
Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Thomas Koshy, "Elementary Number Theory with Applications", 2nd Edition, Academic Press, Elsevier, USA, 2007 for Units I, II, III.
2. William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson Education, New Delhi, 2019 for Units IV, V.

REFERENCES:

1. Ivan Niven, Herbert S. Zukerman & Hugh L. Montgomery, "An Introduction to the Theory of Numbers", Reprint Edition, John Wiley & Sons, New Delhi, 2008.
2. Bernard Menezes, "Cryptography and Network Security", 1st Edition, Cengage Learning India, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand various the concepts of divisibility and canonical decompositions.	Understanding (K2)
CO2	obtain knowledge in theory of congruences and solution of linear congruences.	Applying (K3)
CO3	use different number theoretic function suitably in cryptography.	Applying (K3)
CO4	apply various Primality test and factorisation algorithms to network security problems.	Applying (K3)
CO5	identify the suitable cryptographic techniques to handle real time security issues.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18MAO04 - ADVANCED LINEAR ALGEBRA

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	To provide the skills for applying linear equations, decomposition of matrices and linear transformations in real time engineering problems and impart knowledge of vector spaces.	
Unit - I	**Linear Equations:**	**9**
System of linear equations – Row reduction and echelon forms – Vector equations – Matrix equations – Solution sets of linear systems – Applications of Linear systems: Matrix operations – inverse of a matrix, Matrix factorization – Applications to computer graphics.		
Unit - II	**Vector Spaces:**	**9**
Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit - III	**Inner Product Space:**	**9**
Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Least square technique.		
Unit - IV	**Linear Transformations:**	**9**
General linear transformation – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - V	**Eigenvalues and Eigenvectors:**	**9**
Definition – Orthogonal Diagonalization – Quadratic forms – Quadratic surfaces – Singular value decomposition – Applications.		

Total: 45

TEXT BOOK:

1. Howard Anton & Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, USA, 2014.

REFERENCES:

1. David C. Lay, Steven R. Lay & Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2. Gareth Williams, "Linear Algebra with Applications", 8th Edition, Jones & Barlett Learning, USA, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use the concepts of matrices and vectors in the solution of a system of linear equations.	Applying (K3)
CO2	understand the concepts of vector spaces.	Understanding (K2)
CO3	understand the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Understanding (K2)
CO4	transform the system from one dimension to another and represent the pertinent linear transformation in matrix form.	Applying (K3)
CO5	apply the knowledge of quadratic forms and techniques of singular value decomposition for problems arising in power/control system analysis, signals and systems.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18MAO05 - OPTIMIZATION TECHNIQUES

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	To provide the skills for solving the real time engineering problems involving linear, non-linear, transportation and assignment problems and also impart knowledge in project management and game theoretic concepts.	
Unit - I	**Linear Programming:**	**9**
Introduction – Formulation of Linear Programming Problem – Advantages of Linear Programming methods – Limitations of Linear Programming models – Standard form of LPP – Graphical Method – Simplex Method – Artificial variable techniques – Big M Method.		
Unit - II	**Transportation Problem:**	**9**
Mathematical Formulation of Transportation Problem – Initial basic feasible solution – North West Corner Method – Least Cost Method – Vogel's approximation method – Optimal solution – MODI Method – Degeneracy – Unbalanced transportation problem – Maximization transportation problem.		
Unit - III	**Assignment Problem and Theory of Games:**	**9**
Assignment Problem: Mathematical model of Assignment problem – Hungarian Method – Unbalanced assignment problem. Theory of Games: Two-person zero-sum game – Pure strategies - Game with mixed strategies – Rules of Dominance – Solution methods: Algebraic method – Matrix method – Graphical method.		
Unit - IV	**Project Management:**	**9**
Basic Concept of network Scheduling – Construction of network diagram – Critical path method – Programme evaluation and review technique – Project crashing – Time-cost trade-off procedure.		
Unit - V	**Non-Linear Programming:**	**9**
Formulation of non–linear programming problem – Constrained optimization with equality constraints – Kuhn-Tucker conditions – Constrained optimization with inequality constraints.		

Total: 45

TEXT BOOK:

1. Kanti Swarup, Gupta P.K. & Man Mohan, "Operation Research", 14th Edition, Sultan Chand & Sons, New Delhi, 2014.

REFERENCES:

1. Sharma J.K., "Operations Research – Theory and Applications", 4th Edition, Macmillan Publishers India Ltd., New Delhi, 2009.
2. Gupta P.K. & Hira D.S., "Operations Research: An Introduction", 6th Edition, S.Chand and Co. Ltd, New Delhi, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate and solve linear programming problems.	Applying (K3)
CO2	apply transportation algorithms in engineering problems.	Applying (K3)
CO3	use assignment and game theory concepts in practical situations.	Applying (K3)
CO4	handle the problems of Project Management using CPM and PERT.	Applying (K3)
CO5	solve various types of Non-linear Programming problems.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18PHO01 - THIN FILM TECHNOLOGY
(Offered by Department of Physics)

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

Preamble	This course aims to impart the essential knowledge on deposition, characterization and application of thin films in various engineering fields, and also provides motivation towards innovations.	
Unit - I	**Theories and models of thin film growth:**	**9+3**
Introduction - Theories of thin film nucleation: Impingement, Adsorption and Thermal accommodation - The capillarity model - The atomistic models - Structural consequences of thin film nucleation - The four stages of film Growth - The incorporation of defects during growth.		
Unit - II	**Vacuum technology:**	**9+3**
Principle and working of vacuum pumps: Roots pump, Rotary pump, Diffusion pump, Turbo molecular pump, Cryogenic-pump, Ion pump, Ti-sublimation pump - Measurement of Pressure: Bayet-Albert gauge, Pirani and Penning gauge - Cold cathode and hot cathode ionization gauges - Pressure controlling system (qualitative).		
Unit - III	**Deposition of thin films - Physical methods:**	**9+3**
Thermal evaporation – Electron beam evaporation – Pulsed laser deposition – Ion plating – DC sputtering – RF sputtering – Magnetron sputtering – Reactive sputtering - Molecular beam epitaxy - Demonstration of deposition of thin films by RF sputtering.		
Unit - IV	**Deposition of thin films – Chemical methods:**	**9+3**
Chemical vapor deposition – Sol-gel method - Chemical bath deposition - Hydro thermal methods – Electroplating deposition - Electroless deposition - Spray Pyrolysis - Spin coating.		
Unit - V	**Characterization and Applications of thin films:**	**9+3**
Characterization: X-ray diffraction, Energy dispersive X-ray analysis, Atomic probe microscopy, UV-vis spectroscopy, Four probe resistivity – Applications (qualitative): Thin film resistors, Thin film capacitors, Thin film diodes, Thin film transistors, Thin film solar cells, Thin film gas sensors, Thin films for information storage and Optical coatings.		

Lecture:45, Tutorial:15,Total:60

TEXT BOOK:

1. Maissel L.I. and Glang R., "Hand book of Thin Film Technology", McGraw Hill Inc., 1970 for Units I,II,III, IV.
2. Zhang S., Li L. and Kumar A., "Materials Characterization Techniques", CRC Press, 2009 for Unit V.

REFERENCES:

1. Ohring M., "Material Science of Thin Films", Academic Press, 1992.
2. Goswami A., "Thin Film Fundamentals", New Age International Pvt. Ltd., 2003.
3. Chopra K.L., "Thin Film Phenomena", McGraw Hill Inc., 1969.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	utilize the appropriate theory and models to comprehend the thin film growth process.	Applying (K3)
CO2	apply the principle of vacuum pump to explain select methods to create vacuum and to make use of the principle of vacuum gauge to explain the measurement of vacuum by select methods.	Applying (K3)
CO3	describe the deposition of thin films by select physical methods using the principle of working of respective methods.	Applying (K3)
CO4	explain the deposition of thin films by select chemical methods using the principle of working of respective methods.	Applying (K3)
CO5	make use of select characterization techniques to comprehend the properties of thin films and also to illustrate the various device applications of thin films.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18PHO02 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS

(Offered by Department of Physics)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	This course aims to impart the essential knowledge on the characterization of materials using X-ray diffraction, Raman spectroscopy, UV-visible spectroscopy, Electron microscopy and Scanning tunneling microscopy and their application in various engineering fields, and also provides motivation towards innovations.	
Unit - I	**Introduction to Characterization Techniques and X-Ray Diffraction:**	**9**
Importance of materials characterization - Classification of characterization techniques - Destructive and non-destructive techniques - Crystalline materials - Reciprocal lattice - Theory of X-ray diffraction - Powder and Single crystal X-ray diffraction: Instrumentation, XRD pattern, Systematic procedure for structure determination, Particle size determination, Strain calculation - Applications of X ray diffraction measurements.		
Unit - II	**Raman Spectroscopy:**	**9**
Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation – Near-Infra-Red FT Raman Spectroscopy.		
Unit - III	**Electron Microscopy:**	**9**
Need of Electron Microscopy - Electron Specimen interaction: Emission of secondary electrons, Backscattered electrons, Characteristic X-rays, Transmitted electrons, Specimen interaction volume - Resolution - Scanning electron microscope and Transmission electron microscope: Schematic diagram, Short details of each component and working - Field Emission Gun - Field Emission Scanning electron microscope - Merits of Transmission electron microscope.		
Unit - IV	**Scanning Tunneling Microscopy:**	**9**
Introduction to quantum mechanical tunneling - Basic principles of scanning tunneling microscopy - Two modes of scanning - Interpreting scanning tunneling microscopic images -Applications of scanning tunneling microscopy.		
Unit - V	**Ultra Violet and Visible Spectroscopy:**	**9**
Regions of UV-Visible radiation - Colour and light absorption - The chromophore concept - Beer's and Lambert's laws – Theory of electronic transition - Frank Condon principle – Instrumentation and Working of UV vis spectrometer - Applications of UV visible spectroscopy.		

Total:45

TEXT BOOK:

1. Cullity B.D. and Stock S.R., "Elements of X-ray diffraction ", 3rd Edition, Pearson Education, India, 2003 for Units I,II,III,IV.
2. Banwell C.N., "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill Publications, New Delhi, 2007 for Unit V.

REFERENCES:

1. Holt D.B. and Joy D.C., "SEM micro characterization of semiconductors", Academic Press, New Delhi, 1989.
2. Willard H.H., Merritt L.L., John A. Dean and Settle F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publishers and Distributors, New Delhi.
3. Elton N. Kaufman, "Characterization of Materials (Volume1&2)", Wiley-Interscience, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the concept of X-ray diffraction to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO2	make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO3	determine the micro-structural parameters of materials and to perform surface analysis of materials using the concept of matter waves and electron microscopy.	Applying (K3)
CO4	utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image at the atomic level recorded using scanning tunneling microscopy.	Applying (K3)
CO5	apply the theory of UV-Vis spectroscopy to comprehend the working of UV-Vis spectrophotometer.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18CYO01 - CORROSION SCIENCE AND ENGINEERING

(Offered by Department of Chemistry)

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

Preamble	Corrosion science and engineering aims to equip the students to have wide range knowledge of corrosion and prevention methods in order to meet the industrial needs.	
Unit - I	**Corrosion and its units:**	**9+3**
Importance of corrosion prevention in various industries: direct and indirect effects of corrosion –free energy and oxidation potential criterion of uniform corrosion –Pilling Bedworth ratio and it consequences –units corrosion rate – mdd (milligrams per square decimeter per day) and mpy (Mils per year) –importance of pitting factor – Pourbaix diagrams of Mg, Al and Fe – and their limitations.		
Unit - II	**Mechanism of Corrosion:**	**9+3**
Localized corrosion: electro chemical mechanism Vs. chemical mechanism – Galvanic corrosion – Area effect in anodic and cathodic metal coatings, Organic coatings of bimetallic systems – prediction using emf Series and Galvanic series – Crevice corrosion – Mechanism of differential oxygenation corrosion – Auto catalytic mechanism of pitting due to crevice or differential oxygenation corrosion – Principles and procedures of cathodic protection: Sacrificial anodes and external cathodic current impression – stray current corrosion.		
Unit - III	**Types of Corrosion:**	**9+3**
Inter-granular corrosion: Stainless steels – cause and mechanism (Cr- Depletion theory) – Weld decay and knife line attack – Stress corrosion and fatigue corrosion – Theory of critical corrosion rate in corrosion fatigue. Cavitation damage – Fretting damage – Atmospheric corrosion – Bacterial corrosion – Marine corrosion –High temperature oxidation of metals – Ionic diffusion through protective oxides.		
Unit - IV	**Kinetics of Corrosion:**	**9+3**
Kinetic aspects of corrosion: Over potential activation and concentration over potentials – Exchange current density – Mixed potential theory – corrosion rates of Fe and Zn in air – free acid – effect of oxidizing agents – Phenomenon of passivation – Theories – effect of oxidizing agents and velocity of flow on passivating metals – effect of galvanic coupling of Fe and Ti respectively with Platinum – Noble metal alloying – anodic protection.		
Unit - V	**Prevention of Corrosion:**	**9+3**
Corrosion in inhibition: Inhibitors of corrosion – passivators, adsorbing inhibitors, V.P. inhibitors. Prevention of galvanic crevice, inter granular, Stress and fatigue corrosion at the design stage and in service conditions – control of catastrophic oxidation and Hydrogen disease -control of Bacterial corrosion – Langelier saturation Index and its uses. Corrosion prevention by Coatings – Surface pre-treatment – Hot dip, diffusion and cladded coatings – Phosphating and its uses.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Winston R. & Uhlig H.H., "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, A John Wiley & Sons Inc. Publication, New Jersey, 2008.

REFERENCES:

1. McCafferty E., "Introduction to Corrosion Science", Springer, New York, 2010.
2. Fontanna, "Corrosion Engineering (Materials Science and Metallurgy Series)", McGraw Hill International Education, Singapore, 2005.
3. Pietro Pedeferri, "Corrosion Science and Engineering", Springer Nature Switzerland AG, Switzerland, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the importance of direct and indirect corrosion to familiarize for industrial needs.	Understanding (K2)
CO2	demonstrate the mechanism of different types of corrosion with respect to the environment.	Applying (K3)
CO3	organize the various types and theory of corrosion to understand the corrosion problems.	Applying (K3)
CO4	utilize the theories and kinetics of corrosion to interpret with the real time applications.	Applying (K3)
CO5	summarize the corrosion prevention methods to avoid corrosion related issues.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18CYO02 - INSTRUMENTAL METHODS OF ANALYSIS

(Offered by Department of Chemistry)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	BS	3	1	0	4

Preamble	Instrumental methods of analysis aim to prepare the students to have all-encompassing knowledge of spectral methods in order to identify the molecules and reaction mechanism for the process to enhance application towards the industries.	
Unit - I	**Absorption and Emission Spectroscopy:**	**9+3**
Basic concepts of Absorption and emission spectroscopy – representation of spectra – basic elements of practical spectroscopy – signal to noise ratio - techniques for signal to noise enhancement – resolving power – Fourier transform spectroscopy – evaluation of results – basic principles, instrumentation and applications of atomic absorption, atomic fluorescence and atomic emission spectroscopy.		
Unit - II	**IR, Raman and NMR Spectroscopy:**	**9+3**
Infrared spectroscopy – correlation of IR Spectra with molecular structure, instrumentation, samplings technique and quantitative analysis. Raman Spectroscopy – Classical and Quantum theory instrumentation, Structural analysis and quantitative analysis. Nuclear magnetic resonance spectroscopy – basic principles – pulsed Fourier transform NMR spectrometer – elucidation of NMR spectra and quantitative analysis.		
Unit - III	**Surface Studies:**	**9+3**
Surface study – x-ray emission spectroscopy (XES), electron spectroscopy for chemical analysis (ESCA) - UV photo electron spectroscopy (UPS)- X- ray photo electron spectroscopy (XPS) - Auger emission Spectroscopy (AES) - Transmission Electron microscopy (TEM) - Scanning Electron microscopy (SEM) - Surface tunneling microscopy (STEM) - Atomic force microscopy (AFM).		
Unit - IV	**Mass Spectroscopy:**	**9+3**
Mass spectroscopy – Ionization methods in mass spectroscopy – mass analyzer – ion collection systems - correlation of molecular spectra with molecular structure. Instrumentation design and application of Fourier transform mass spectroscopy (FT-MS)- Inductively coupled plasma mass spectroscopy (ICP-MS) - Secondary Ion Mass Spectroscopy (SIMS) and Ion microprobe mass analyzer (IMMA).		
Unit - V	**Thermal Analysis:**	**9+3**
Thermal analysis: principles and instrumentations and applications of thermogravimetry (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), evolved gas detection, thermo mechanical analysis and Thermometric titrimetry.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Willard H.H., Merritt L.L., Dean J.A & Settle F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publishers & Distributors, New Delhi, 2012.

REFERENCES:

1. Chatwal G.R. & Anand Sham K., "Instrumental Methods of Chemical Analysis", 5th Edition, Himalaya Publishing House, Girgaon, Mumbai, 2019.
2. Srivastava A.K. & Jain P.C., "Instrumental Approach to Chemical Analysis", 4th Edition, S Chand and Company Ltd, New Delhi, 2012.
3. Sharma B.K., "Instrumental Method of Chemical Analysis", Krishna Prakashan Media Pvt. Ltd., Meerut, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the basics of spectroscopy to understand the instrumentation of various spectral techniques.	Understanding (K2)
CO2	apply the IR, Raman and NMR for quantitative analysis of the sample.	Applying (K3)
CO3	apply the various techniques for the better understanding of surface morphology.	Applying (K3)
CO4	explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample.	Understanding (K2)
CO5	illustrate the thermal analysis for the identification of thermal stability of the compounds.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18CYO03 - WASTE AND HAZARDOUS WASTE MANAGEMENT

(Offered by Department of Chemistry)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	BS	3	0	0	3

Preamble	Waste and Hazardous waste management aims to equip the students to have a wide-range knowledge on waste management	
Unit – I	**Solid Waste Management:**	**9**
Solid wastes: Definition, types, sources, classification and composition of solid waste- Solid waste management system – Factors affecting solid waste management system – Solid waste processing technologies – incineration, combustion, stabilization, solidification, chemical fixation, encapsulation, composting, vermicomposting – Energy from waste –Biogasification –Anaerobic digestion, pyrolysis, refuse derived fuels; Landfill leachate and gas management, Landfill bioreactors – Recycling of household and commercial waste, recycling of paper, recycling of tire, recycling of plastics – Health and Environmental effects of Solid Waste – SWM: Indian scenario – Characteristics and quantity of various wastes.		
Unit – II	**Hazardous Waste Management:**	**9**
Hazardous waste Management: Identification and sources – characteristics and categorization – collection, segregation, packaging, labelling, transportation, processing (3R) – risk assessment and waste management treatment and disposal – storage and leak detection – site selection criteria, manifest system and records – Indian scenario – Responsibilities of various authorities. Radioactive Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal.		
Unit – III	**E-Waste and Biomedical Waste Management:**	**9**
E-Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal. Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste – categories and classification of biomedical waste – hazard of biomedical waste – need for disposal of biomedical waste – waste minimization – waste segregation and labelling – waste handling and collection- Treatment – autoclaving, Incineration, Chemical Disinfection – Disposal – Infection control Practices- status in India.		
Unit – IV	**Pollution from Major Industries and Management:**	**9**
Introduction- sources and characteristics – waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts.		
Unit – V	**Solid Waste Management Legislation:**	**9**
Solid waste management plan – Solid Waste (Management and Handling) Rules, 2000, 2016 and amendments if any – Biomedical Waste (Management and Handling) Rules, 2016; Notification of Ash utilization 1999, 2003, 2009, 2015 and amendments if any – Plastic Waste Management Rules, 2016 – E-Waste Management Rules, 2016 – Bio-Medical Waste Management Rules, 2016 – Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 – Construction and Demolition Waste Management Rules, 2016.		

Total:45

TEXT BOOK:

1. John Pichtel, “Waste Management Practices: Municipal, Hazardous, and Industrial”, 2nd Edition, CRC Press, Boca Raton, Florida, 2014 for Unit II, III.
2. Sharma U.C. & Neetu Singh, “Environmental Science and Engineering, Volume 5: Solid Waste Management”, 2nd Edition, Studium Press, United State of America, 2017 for Unit I,IV,V.

REFERENCES:

1. VanGuilder & Cliff, "Hazardous Waste Management: An Introduction", Har Cdr Edition, Mercury Learning & Information, Herndon, VA, 2011.
2. Karen Hardt, "Solid Waste Management", 1st Edition, Callisto Reference, Germany, 2018.
3. Majeti Narasimha Vara Prasad, Meththika Vithanage & Anwesha Borthakur, "Handbook of Electronic Waste Management: International Best Practices and Case Studies", 1st Edition, Butterworth-Heinemann, United Kingdom, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the technical points that are required to set up a solid waste management system.	Applying (K3)
CO2	select the various disposal methods of hazardous wastes like radioactive wastes.	Understanding (K2)
CO3	organize the appropriate method for managing e-waste and biomedical wastes.	Applying (K3)
CO4	identify to plan minimization of industrial wastes.	Applying (K3)
CO5	relate the legal legislation to solid waste management.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO01 – GERMAN LANGUAGE LEVEL 1

(Offered by Department of Electronics and Communication Engineering)

Programme& Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Language	5,6,7,8	HS	4	0	0	4

Preamble	To acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations.	
Unit - I	**Contacts (Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit - II	**Accommodation (Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Working Environment Communication (ArbeitenSie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style (Kleidung und mode) :**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative.		
Unit - V	**Health and Vacation (Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nichtdürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, ZumSchl*		

Total:60

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO02 – JAPANESE LANGUAGE LEVEL 1

(Offered by Department of Electronics and Communication Engineering)

Programme& Branch	All BE/BTech Engineering & Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Language	5,6,7,8	HS	4	0	0	4

Preamble	To understand the basics of Japanese language which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit - I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit - II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit - III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit - IV	**Introduction to If clause and Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-110 Kanjis		
Unit - V	**Introduction to Counters:**	**12**
How to use numbers-How to use quantifiers-Past form of adjectives and Nouns-Way to say preference-Way of expression degrees of an action-Other necessary particles-How to use numbers-How to use quantifiers-Past form of adjectives		

Total:60

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of time, counters and job-related information	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO03 - DESIGN THINKING FOR ENGINEERS

(Offered by Department of Computer Science and Engineering)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	7	OE	3	0	0	3

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO04 - INNOVATION AND BUSINESS MODEL DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

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

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

Total:45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO05 - GERMAN LANGUAGE LEVEL 2

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 1	5/6/7/8	HS	4	0	0	4

Preamble	This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations.	
Unit - I	**Contacts(Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit - II	**Accomodation(Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Are you Working?(Arbeiten Sie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking abou Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style(Kleidung und mode):**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative		
Unit - V	**Health and Vacation(Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*		

Total: 60

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO06 - GERMAN LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 2	**5/6/7/8**	**HS**	**3**	**0**	**0**	**3**

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

Total: 45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO07 - GERMAN LANGUAGE LEVEL 4

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 3	5/6/7/8	HS	3	0	0	3

Preamble	This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations.	
Unit - I	**Learning (Lernen):**	**9**
Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ		
Unit - II	**Athletic (Sportlich):**	**9**
Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ		
Unit - III	**Living Together (Zusammen Leben):**	**9**
To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.		
Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**
Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ.		
Unit - V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**
Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.		

Total: 45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO08 - JAPANESE LANGUAGE LEVEL 2

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 1	5/6/7/8	HS	4	0	0	4

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit - I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit - II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit - III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit - IV	**Introduction to If clause and remaining Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis		
Unit - V	**Introduction to giving and receiving with te form and "when, even if" usages:**	**12**
Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.		

Total: 60

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO09 - JAPANESE LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 2	5/6/7/8	HS	3	0	0	3

Preamble	The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life	
Unit - I	**Introduction to Potential verbs:**	**9**
Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.		
Unit - II	**Introduction to Transitive and Intransitive verbs:**	**9**
Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences- Conjunctions-Basic Questions and kanji's.		
Unit - III	**Introduction to Volitional forms:**	**9**
Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.		
Unit - IV	**Introduction to Imperative and Prohibitive verbs:**	**9**
Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.		
Unit - V	**Introduction to Conditional form and Passive verbs:**	**9**
Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)
CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO10 - JAPANESE LANGUAGE LEVEL 4

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 3	5/6/7/8	HS	3	0	0	3

Preamble	The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people.	
Unit - I	**Introduction to Reasoning:**	**9**
Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's.		
Unit - II	**Introduction to Exchanging of things:**	**9**
Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's.		
Unit - III	**Introduction to States of an Action:**	**9**
Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's.		
Unit - IV	**Introduction to Causative Verbs:**	**9**
Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's.		
Unit - V	**Introduction to Relationship in Social Status:**	**9**
Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)
CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Orally Presented Materials.	Understanding (K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

18GEO11 - NCC Studies(Army Wing) – I

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.	
Unit - I	**NCC Organisation and National Integration:**	**9**
NCC Organisation – History of NCC- NCC Organisation- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit - II	**Basic physical Training and Drill:**	**9**
Basic physical Training – various exercises for fitness(with Demonstration)-Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION)		
Unit - III	**Weapon Training:**	**9**
Main Parts of a Rifle- Characteristics of 5.56mm INSAS rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing(WITH PRACTICE SESSION) - Characteristics of 7.62mm SLR- LMG- carbine machine gun.		
Unit - IV	**Social Awareness and Community Development:**	**9**
Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility		
Unit - V	**Specialized Subject (ARMY):**	**9**
Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading including practical.		

Lecture :45, Practical:30, Total:75

TEXT BOOK:

1. "National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.

REFERENCES:

1. "Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.
2. "Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3. "NCC OTA Precise", published by DG NCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders..	Applying (K3)
CO3	basic knowledge of weapons and their use and handling.	Applying (K3)
CO4	understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Applying (K3)
CO5	acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						

18GEO12 - NCC STUDIES (AIR WING) – I
(Offered by Department of Information Technology)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character , camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets.	
Unit – I	**NCC Organization and National Integration:**	**9**
NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honors' and Awards – Incentives for NCC cadets by central and state govt. History and Organization of IAF-Indo-Pak War-1971-Operation Safed Sagar. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit – II	**Drill and Weapon Training:**	**9**
Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION). Main Parts of a Rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing (WITH PRACTICE SESSION).		
Unit – III	**Principles of Flight:**	**9**
Laws of motion-Forces acting on aircraft–Bernoulli's theorem-Stalling-Primary control surfaces – secondary control surfaces-Aircraft recognition.		
Unit - IV	**Aero Engines:**	**9**
Introduction of Aero engine-Types of engine-piston engine-jet engines-Turboprop engines-Basic Flight Instruments-Modern trends.		
Unit – V	**Aero Modeling:**	**9**
History of aero modeling-Materials used in Aero-modeling-Types of Aero-models – Static Models-Gliders-Control line models-Radio Control Models-Building and Flying of Aero-models.		

Lecture :45, Practical30, Total:75

TEXT BOOK:

1	"National Cadet Corps- A Concise handbook of NCC Cadets" by Ramesh Publishing House, New Delhi,2014.

REFERENCES:

1	"Cadets Handbook – Common Subjects SD/SW" by DG NCC, New Delhi.
2	"Cadets Handbook – Specialised Subjects SD/SW" by DG NCC, New Delhi.
3	"NCC OTA Precise" by DGNCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Applying (K3)
CO3	illustrate various forces and moments acting on aircraft	Applying (K3)
CO4	outline the concepts of aircraft engine and rocket propulsion	Applying (K3)
CO5	design, build and fly chuck gliders/model airplanes and display static models.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						