ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

(Choice Based Credit System) (Full-Time)

REGULATIONS AND SYLLABUS

(2018-2019 Onwards)

REGULATIONS

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as courses of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamil Nadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma programme in Engineering of the State Board of Technical Education, Tamil Nadu (listed below) will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

Diploma Programmes Eligible for the B.E (Lateral Entry) Programmes

Electronics and Instrumentation Engineering	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering

2. Branches of Study in B.E.

BRANCH I	-	Chemical Engineering
BRANCH II	-	Civil Engineering
BRANCH III	-	Civil and Structural Engineering
BRANCH IV	-	Computer Science and Engineering
BRANCH V	-	Electrical and Electronics Engineering
BRANCH VI	-	Electronics and Communication Engineering
BRANCH VII	-	Electronics and Instrumentation Engineering
BRANCH VIII	-	Information Technology
BRANCH IX	-	Mechanical Engineering
BRANCH X	-	Mechanical Engineering (Manufacturing)

3. Courses of Study and Scheme of Examinations

The courses of study with respective syllabi and the scheme of Examinations are given separately.

4. Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities / Social Sciences/ Management, Basic Sciences, Engineering Sciences, Professional Core, Professional Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory and practical courses. The total credits for the entire degree Programme is 166 (124 for lateral entry students).

5. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed the prescribed examinations in all the four academic years. For the award of the degree, a student has to

5.1. Earn a minimum of 166 credits (124 for lateral entry students).

5.2. Serve in any one of the Co-curricular activities such as

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO) and
- Youth Red Cross (YRC)

for at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(or)

Enrol as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE, IEEE, SAE, ASHRAE, CSI and IWS

5.3. B.E (Honours) Degree

A student shall be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. Thus the total credits are 186. Out of 186 credits(144credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure-II) in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses of SWAYAM portal also.

5.4. B.E Degree with Minor Engineering

A student shall be eligible to get Under Graduate degree with additional Minor Engineering, if he/she completes an additional 20 credits. Out of the 186 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure-II) in the Faculty of Engineering and Technology in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses offered in SWAYAM portal also.

Annexure-II

Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
Electronics and Instrumentation Engg.	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engg 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engg 6. Computer Science and Engineering 7. Information Technology

6. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture/tutorial per week and half credit for one hour for laboratory or practical or drawing course per week.

7. Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than seven years from the time of admission.

8. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enrol for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 166 (124 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

8.1. Slow Learners

The **slow learners** may be allowed to withdraw certain courses with the approval by the Head of the Department and those courses may be completed by them in the fifth year of studyand still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VIIsemester and take up those courses in the fifth year of study. However, courses

withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

8.2. Advance Learners

The **advance learners** may be allowed to take up the open elective courses of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training/project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

9. Mandatory Internship (Industrial Training)

To promote industrial internship at the graduate level in technical institutes and also to enhance the employability skills of the students passing out from Technical Institutions, the internship for the students at different stages of the programme, is included in the curriculum. The student has to undergo the internship during the summer vacation, after the II semester / IV semester/ VI semester of the programmeas per the details outlined below. Further the student has to submit a report on completion of the internship during the subsequent Odd semester that is in the III / V / VII semesters respectively.

9.1. During the summer vacation, after the II Semester,

The student must get involved in any of the following **Inter/ Intra Institutional**

Activities for 4 weeks duration:

(i) Training with higher Institutions; Soft skill training organized by Trainingand Placement Cell.

(ii) Contribution at incubation/ innovation /entrepreneurship cellof the institute.

(iii) Participation in conferences/ workshops/ competitions.

(iv) Learning at Departmental Lab/ Institutional workshop.

(v) Working for consultancy/ research project within the University.

(vi) Participation in activities like IPR workshop /Leadership Talks/ Idea/ Design/ Innovation/ Technical Expos.

9.2. During the summer vacation, after the IV Semester and also after the VI Semester,

The student may choose any of the following **Internship / Innovation /**

Entrepreneurship related activities for **4 weeks**duration:

(i) Work on innovation or entrepreneurial activities resulting in start-up

(ii) Undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises

(iii) Undergo internship with National Employment Enhancement Mission (NEEM) Facilitator.

10. Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his/her period of study in an industry and complete his/her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

11. Mandatory Induction program

A 3-week long induction program for the UG students entering the institution, right at the start is proposed. Normal classes start only after the induction program is over. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entireduration oftheprogram.

Physical Activity
Creative Arts
Imparting Universal Human Values
Literary Activities
Conduct of crash courses on soft skills
Lectures by Eminent People
Visits to Local Area
Familiarization to Dept./Branch & Innovative practices

12. Electives

The elective courses fall under two basic categories: Professional Electives and Open Electives.

12.1. Professional Elective courses

The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned.

12.2. Open Elective courses

Apart from the various Professional elective courses, a student must study three open elective coursestwo of which offered by the Department concerned and the other open elective course offered by any other Department in the Faculty of Engineering & Technology during either sixth or seventh or eighth semester of study, with the approval of the Head of the Department and the Head of the Department offering the course.

12.3. MOOC (SWAYAM) Courses

Further, the student can be permitted to earn not more than 20 % of his total credits (that is 32 credits) by studying the Massive Open Online Courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent to the

professional elective and/or open elective courses. Thus the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

12.4. Value added courses (Inter Faculty Electives)

Of the four open elective courses, a student must study one value added course that is offered by other Faculties in our University either in sixth or seventh semester of the B.E programme.

12.5. One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology.

12.5.1. Industry Expert

For one credit courses, a relevant potential topic may be selected by a committee consisting of the Head of the Department concerned and the Board of Studies member from the Department and a senior faculty member from the Department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two one credit courses (one each in VI and VII semesters). They shall be allowed to take one credit courses offered in other Departments with the permission of Head of the Department offering the courses. A separate mark sheet shall be issued for one credit courses.

12.5.2. NSQF Courses

A student can be permitted to acquire additional credits not more than two by undergoing any two of the one credit courses conducted under the auspices of National Skills Qualification Framework (NSQF). NSQFis a nationally integrated education and competency based skill and quality assurance framework that will provide for multiple pathways, horizontal as well as vertical, including vocational education, vocational training, general education and technical education, thus linking one level of learning to another higher level. This will enable a student to acquire desired competency levels, transit to the job market and at an opportune time, return for acquiring additional skills to further upgrade their competencies.

13. Assessment

13.1.Theory Courses

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

13.2. Practical Courses

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

13.3. Project Work

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

13.4. Industrial Internship

After attending the internship during the summer vacation of even semester (II / IV / VI semester), the student has to present a report at the start of the subsequent odd semester (III / V / VII semester) to the committee which will assess and award marks out of 100. The committee is constituted with an Internship Coordinator and a minimum of two members nominated by the Head of the Department for each class.

14. Substitute Assessment

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

15. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

16. Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator. The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All the Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.

For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from third to eighth semester will be as follows:

- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory/40 marks for seminar/ industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case ofI & II Semester) for approvaland transmission to the Controller of Examinations.

17. Attendance requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

18. Temporary break of study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

If a student wishes to apply for break of study, the student shall apply to the

Dean in advance, in any case, not later than the last date of the first assessment period.

The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the Department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of seven years.

19. Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' will appear in the mark sheet for such candidates.

20. Passing and declaration of examination results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of Examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course, is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA in the mark sheet must reappear for the examination of the courses except for Honours courses.

A student who obtains letter grade W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-valuation of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

21. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

21.1. Honours Degree

To obtain **Honours Degree** a student must earn a minimum of **186 credits** within four years (144credits within three years for lateral entry students) from the time of admission, pass all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.2. First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 166 Creditswithin four years (124 credits within three years for lateral entry students) from the time of admission, by passing all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.3. First Class

To obtainB.E Degree First Class, a student must earn a minimum of 166 credits within ***five*** years (124 credits within ***four***years for lateral entry students) from the time of admission and obtain a CGPA of 6.75 or above for all the courses from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

21.4. Second Class

For Second Class, the student must earn a minimum of 166 credits within **seven** years (124 credits within **six** years for lateral entry students) from the time of admission.

21.5. B.E Degree with Minor Engineering

For Minor Engineering, the student must earn a minimum of 186 credits within four years (144 credits within three years for lateral entry students) from the time of admission, pass all the courses. The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class will be applicable for this also.

22. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates who are eligible to get the B.E. degree in First Class with Distinction will be ranked next after those with Honours on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The Candidates passing with First Class will be ranked next after those with distinction on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

23. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

VISION

To nurture higher echelons of technology through participative education, innovative and collaborative research with a view to bring out employable graduates of International standard.

MISSION

M1 To establish state of the art facilities related to diverse dimensions in the field of Instrumentation Engineering

M2 To foster higher quality of education with equivocal focus in theory and practical areas of Electronics, Control and Instrumentation Engineering.

M3 To ensure that the dissemination of knowledge reaches the stakeholders and forge the opening of a fresh flair of human resources

M4 To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one's career

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PE01 To nurture in a spirit of self-confidence, Tolerance and adaptability among the graduates pursuing this programme

PE02 To inculcate echelons of technical skill and academic excellence for enabling the graduates to choose their field of expertise.

PE03 To foster curricular and extra-curricular attributes with a perspective to ensure the graduates accomplish their professional career.

PE04 To promote awareness among graduates for lifelong learning and inculcate professional ethics.

PROGRAMME OUTCOMES (PO)

After the successful completion of the B.E. (Electronics and Instrumentation Engineering) degree programme, the students will be able to:

PO1	**Integration of knowledge** Apply the knowledge of mathematics, science and engineering fundamentals in analog and digital electronic systems, instrumentation and control engineering
PO2	**Problem analysis** Formulate, solve and analyze complex problems in electrical circuits, electronic systems, instrumentation and control engineering
PO3	**Design and development of solutions** Apply the acquired knowledge for designing systems/processes to address the specific needs and to pull off solution, with appropriate consideration for health, safety, and environmental issues
PO4	**Use of modern tools and techniques** Select and apply appropriate modern engineering tools including prediction and modelling software packages, Distributed Control System, Programmable Controllers and advanced processors.
PO5	**Collaborative and multidisciplinary approach** Gain exposure to attain knowledge and understand inter disciplinary and multidisciplinary engineering sciences
PO6	**Ethical practices** Acquire professional and intellectual integrity, professional code of conduct, ethics on professional practices, understanding responsibilities and norms for sustainable development of society.
PO7	**Communication skills** Interact with the engineering community and with society at large, regarding intricate engineering activities on technical perspectives and emerge as an efficient motivator.
PO8	**Project management** Understand the engineering and management concepts and demonstrate the knowledge as an entrepreneur or member/leader in teams and multidisciplinary tasks in their profession

PO9	**Lifelong learning** Appreciate the need for self preparation and life-long learning independently in the broadest context of technological challenges
PO10	**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
PO11	**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
PO12	**Individual and team work** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Mapping PO with PEO												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PEO1	✓	✓	✓									
PEO2				✓	✓						✓	✓
PEO3					✓	✓	✓	✓				
PEO4						✓			✓	✓		

DETAILS OF COURSE CODE

Code (First Two digits)	**Details**
00	Common course for the faculty
01	Civil Engg. Course
02	Civil and Structural Engg. course
03	Mechanical Engg. Course
04	Mechanical Engg (Manufacturing). Course
05	Electrical and Electronics Engg. Course
06	Electronics and Instrumentation Engg. course
07	Chemical Engg. course
08	Computer Science and Engg. course
09	Information Technology course
10	Electronics and Communication Engg. course
YY	Code of the programme concerned (01 to 10)

Code (3rd and 4th Digits)	**Details**
HS	Humanities Theory
HP	Humanities Practical
BS	Basic Science Theory
BP	Basic Science Practical
ES	Engineering Science Theory
SP	Engineering Science Practical
PC	Professional Core Theory
CP	Professional Core Practical
PE	Professional Elective Theory
EP	Professional Elective Practical
ST	Seminar / Industrial Training
OE	Open Elective Theory
PV	Project and Viva-voce

5th digit represents the semester and 6th and 7th digits represent the serial number of courses.

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18ETBS101	BS-I	Physics	3	1	0	25	75	100	4
18ETBS102	BS-II	Mathematics – I	3	1	0	25	75	100	4
18ETES103	ES-I	Basic Electrical Engineering	3	1	0	25	75	100	4
18ETBP104	BSP-I	Physics Laboratory	0	0	3	40	60	100	1.5
18ETSP105	ESP-I	Electrical Engineering Laboratory	0	0	2	40	60	100	1
18ETSP106	ESP-II	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
			Total Credits						**17.5**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18ETHS201	HS-I	English	2	0	0	25	75	100	2
18ETBS202	BS-III	Chemistry	3	1	0	25	75	100	4
18ETES203	ES-II	Programming for Problem Solving	3	0	0	25	75	100	3
18ETBS204	BS-IV	Mathematics – II	3	1	0	25	75	100	4
18ETHP205	HSP-I	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
18ETBP206	BSP-II	Chemistry Laboratory	0	0	3	40	60	100	1.5
18ETSP207	ESP-III	Computer Programming Lab	0	0	4	40	60	100	2
18ETSP208	ESP-IV	Engineering Graphics and Drafting	1	0	4	40	60	100	3
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.			**Total Credits**						**20.5**

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18ETBS301	BS-V	Engineering Mathematics III	3	1	-	25	75	100	4
18ETES302	ES-III	Environmental Studies	3	-	-	25	75	100	3
18ETES303	ES-IV	Engineering Mechanics	3	-	-	25	75	100	3
18EIES304	ES-V	Thermodynamics and Fluid Mechanics	2			25	75	100	2
18EIPC305	PC-I	Electrical Circuit Analysis	3	-	-	25	75	100	3
18EIPC306	PC-II	Analog Electronic Circuits	3	1		25	75	100	4
18EISP307	ESP-V	Fluid Mechanics & Hydraulics Machinery Lab	-	-	3	40	60	100	1.5
18EICP308	PCP-I	Electric Circuits Lab	-	-	3	40	60	100	1.5
18EICP309	PCP-II	Analog Electronics Lab	-	-	3	40	60	100	1.5
18ETIT310	IT-I	Internship Inter/ Intra Institutional Activities*	Four weeks during the summer vacation at the end of II Semester				100	100	4.0
* For the Lateral entry students total credit for III Semester is 23.5 as they are exempted from internship during summer vacation of II semester.						**Total Credits**			**27.5**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18EIBS401	BS-VI	Probability, Random Processes and Numerical Methods	3	-	-	25	75	100	3
18EIES402	ES-VI	Electrical Technology	2	-	-	25	75	100	2
18EIPC403	PC-III	Control Systems	3	-	-	25	75	100	3
18EIPC404	PC-IV	Digital Electronics	3	-	-	25	75	100	3
18EIPC405	PC-V	Electronic Instrumentation and Measurement Techniques	3	-	-	25	75	100	3
18EIPC406	PC-VI	Transducers and Measurement Systems	3	-	-	25	75	100	3
18EICP407	PCP-III	Control Systems Lab	-	-	3	40	60	100	1.5
18EICP408	PCP-IV	Digital Electronics Lab	-	-	3	40	60	100	1.5
18EICP409	PCP-V	Sensors and Signal Conditioning Lab	-	-	3	40	60	100	1.5
			Total Credits						**21.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									
SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18EIPC501	PC-VII	Industrial Instrumentation	3	-	-	25	75	100	3
18EIPC502	PC-VIII	Signals and Systems	3	-	-	25	75	100	3
18EIPC503	PC-IX	Process Control	3	-	-	25	75	100	3
18EIPC504	PC-X	Microprocessors and Microcontrollers	3			25	75	100	3
18EIPE505	PE-I	Professional Elective I	3	-	-	25	75	100	3
18EIPE506	PE-II	Professional Elective II	3	-		25	75	100	3
18EICP507	PCP-VI	Industrial Instrumentation Lab	-	-	3	40	60	100	1.5
18EICP508	PCP-VII	Process Control Lab	-	-	3	40	60	100	1.5
18EICP509	PCP-VIII	Microprocessors Lab	-	-	3	40	60	100	1.5
18ETIT510	IT-II	Industrial Training / Rural Internship/Innovation / Entrepreneurship	Four weeks during the summer vacation at the end of IV Semester				100	100	4.0
			Total Credits						**26.5**
SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18EIPC601	PC-XI	Digital Signal Processing	3	-	-	25	75	100	3
18EIPC602	PC-XII	Instrumentation System Design	3	-	-	25	75	100	3
18EIPE603	PE-III	Professional Elective - III	3	-	-	25	75	100	3
18EIPE604	PE-IV	Professional Elective - IV	3	-	-	25	75	100	3
18EIPE605	PE-V	Professional Elective –V	3	-	-	25	75	100	3
18YYOE606	OE-I	Open Elective - I (inter department - FEAT)	3	-	-	25	75	100	3
18EICP607	PCP-IX	Instrumentation System Design Lab	-	-	3	40	60	100	1.5
18EICP608	PCP-X	Signal Processing and Embedded Systems Lab	-	-	3	40	60	100	1.5
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.			**Total Credits**						**21.0**

SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18ETHS701	HS-II	Engineering Ethics	2	-	-	25	75	100	2
18EIPC702	PC-XIII	Computer Control of Processes	3	-	-	25	75	100	3
18EIPE703	PE-VI	Professional Elective-VI	3	-	-	25	75	100	3
18EIPE704	PE-VII	Professional Elective-VII	3	-	-	25	75	100	3
18YYOE705	OE-II	Open Elective - II (inter department- Allied Branch)	3	-	-	25	75	100	3
18EICP706	PCP-XI	Industrial Automation Lab	-	-	3	40	60	100	1.5
18ETIT707	IT-III	Industrial Training / Rural Internship/Innovation / Entrepreneurship	Four weeks during the summer vacation at the end of VI Semester				100	100	4.0
			Total Credits						19.5

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
18EIOE801	OE-III	Open Elective – III (from the same Department)	3	-	-	25	75	100	3
18EIOE802	OE-IV	Open Elective – IV (from the same Department)	3	-	-	25	75	100	3
18EIPV803	PV-I	Project Work and Viva-Voce	-	PR	S	40	60	100	6
				10	2				
						Total Credits			12

L	No. of Lecture Hours	PR	No. of Hours for Discussion on Project work
T	No. of Tutorial Hours	S	No. of Seminar Hours on Industrial Training / Project
P	No. of Practical Hours	FE	Final Examination Marks
CA	Continuous Assessment Marks		
Credits	Credit points allotted to that course	Total	Total Marks

S.No.	COURSE CODE	LIST OF PROFESSIONAL ELECTIVES
1	18EIPESCN	Virtual Instrumentation and Smart Sensors
2	18EIPESCN	Analytical Instrumentation
3	18EIPESCN	Biomedical Instrumentation
4	18EIPESCN	Power Plant Instrumentation
5	18EIPESCN	Unit Operations and Control
6	18EIPESCN	Fluid Mechanics and Hydraulic Machinery
7	18EIPESCN	Principles of Communication systems
8	18EIPESCN	Digital System Design
9	18EIPESCN	Real Time Operating Systems
10	18EIPESCN	Computer Networks and DCS
11	18EIPESCN	VLSI System Design
12	18EIPESCN	Microcontroller Based System Design
13	18EIPESCN	Embedded Systems
14	18EIPESCN	Power Electronics, Drives and Control
15	18EIPESCN	Soft Computing Techniques for Process Control
16	18EIPESCN	Non-linear Control Systems

17	18EIPESCN	Optimal Control
18	18EIPESCN	Model Predictive Control
19	18EIPESCN	Fault Detection and Diagnosis

S.No.	COURSE CODE	LIST OF OPEN ELECTIVES
1	18EIOESCN	Transducer Engineering
2	18EIOESCN	Test and Measuring Instruments
3	18EIOESCN	Measurements in Process Industries
4	18EIOESCN	Industrial Automation and Control
5	18EIOESCN	Nano Materials and Nano Electronics
6	18EIOESCN	Micro Electro Mechanical Systems
7	18EIOESCN	Instrumentation in Petrochemical Industries

S.No.	COURSE CODE	LIST OF HONOUR ELECTIVES	CREDITS
1	18EIHESCN	Advanced Topics in PID Control	4
2	18EIHESCN	Industrial Safety	3
3	18EIHESCN	Robotics & Automation	3
4	18EIHESCN	Fiber Optics and Laser Instrumentation	3
5	18EIHESCN	Process Data Analytics	4
6	18EIHESCN	SCADA Systems and Application	3

S.No.	COURSE CODE	LIST OF MINOR ENGINEERING ELECTIVES	CREDITS
1	18EIMISCN	Transducer Engineering	3
2	18EIMISCN	Test and Measuring Instruments	3
3	18EIMISCN	Measurements in Process Industries	3
4	18EIMISCN	Essentials of Control Engineering	4
5	18EIMISCN	Industrial Automation and Control	4
6	18EIMISCN	Instrumentation in Petrochemical Industries	3

SYLLABUS

18ETBS301	ENGINEERING MATHEMATICS III	L	T	P	C
		3	1	-	4

Course Objectives

- To learn, partial differential equations, Fourier series, Boundary value problems.
- To learn the transforms such as Sine, Cosine, Fourier transform and Z-transforms.
- To gain knowledge of the method to find the Solution of difference equations.

Unit–I : Partial Differential Equations

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit–II : Fourier Series

Dirichle's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

Unit–III : Boundary value problems

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit–IV : Fourier Transform

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's identity.

Unit–V : Z – Transform and difference equations

Z -transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

TEXT BOOKS

1. Kandasamy P , Tilagavathy K and Gunavathy K, "Engineering Mathematics",6th edition., (Vol I & II) S.Chand& Co Ltd. 2006, New Delhi.
2. Ventakataraman M K, "Engineering Mathematics", The National Publishing Co.,Chennai,2003.

REFERENCES

1. Veerarajan T, "Engineering Mathematics", 3 rd edition, TataMcGraw Hill Pub., 2005.
2. Singaravelu A, "Engineering Mathematics", Meenakshi Publications, Chennai, 2004.

COURSE OUTCOMES

At the end of the course the students will be able to acquire knowledge on

1. Partial differential equations.
2. Fourier series.
3. Fourier transform.
4. Z-transforms and the methods of solving them.
5. Solving boundary value problems.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓								✓	
CO2	✓		✓									
CO3	✓		✓								✓	
CO4	✓		✓								✓	
CO5	✓		✓								✓	

18ETES302	**ENVIRONMENTAL STUDIES**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To realize the importance of environment for engineering students.
- To understand the basis of ecosystems
- To make aware the student about global environmental problems and natural disasters.
- To give the ideas about advance technologies of Engineering that will useful to protect environment.

Unit–I

Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness.

Natural resources - Forest resources: use and over-exploitation, deforestation,

case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit–IV

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management : floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

Unit–V

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value

Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

Field work

Visit to a local area to document environmental assets-river/forest/grassland hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural - Study of common plants, insects, birds -Study of simple ecosystems-pond, river, hill slopes, etc. **(Field work Equal to 5 lecture hours)**

TEXT BOOKS

1. Agarwal, K.C. Environmental Biology, Nidi Publ, Ltd. Bikaner, 2001
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net

REFERENCES

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001,
4. Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
5. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
6. Down to Earth, Centre for Science and Environment
7. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev.,
8. Environment & Security.Stockholm Env.Institute Oxford Univ. Press. 473p.
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural
10. History Society, Bombay
11. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment.
12. Cambridge Univ. press 1140p.
13. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. HimalayaPub. House, Delhi 284 p.
14. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions,Web enhanced edition. 639p.
15. Mhaskar A.K., Matter Hazardous, Techno-Science Publication
16. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co.
17. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
18. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
19. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut Survey of the Environment, The Hindu (M)
20. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science.
21. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliancesand Stadards, Vol I and II, Enviro Media.
22. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication.
23. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia,USA 499p.

COURSE OUTCOMES

At the end students can able to

1. Understand the importance of environment.
2. Analyze the importance of environment in engineering.
3. Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4. Employ awareness among the society about environmental problems and natural disasters.
5. Practice according to the present and future environmental issues.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2	✓	✓	✓								✓	
CO3		✓	✓									
CO4		✓										
CO5	✓										✓	

18ETES303	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To introduce the fundamentals of forces and their effects with their governing laws.
2. To understand the definitions of particle, body forces and their equilibrium conditions.
3. To understand dynamics and its related motions.

Unit-I: Basics & Statics Of Particles

Introduction - Units and Dimensions – Laws of Mechanics, Lami's theorem, Parallelogram and triangular Law of forces Vectors – vectorial representation of forces and moments – vector operation: addition, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle Force in space - Equilibrium of a particle in space - Equilibrium systems of forces – Principle of transmissibility Single equivalent force

Unit-II: Equilibrium Of Rigid Bodies

Free body diagram – types of supports and their reactions – requirements of stable Equilibrium – Moment and Couples – Moment of forces about a point and about an axis – Vectorial representation of moments and couples Scalar components of a moment – Varignon's theorem – Equilibrium of rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions- Examples

Unit-III: Properties Of Surfaces And Solids

Determination of area and volumes – First moment of area and the Centroid of section – Rectangle. Circle, triangle from integration – T section, I section, Angle

section, Hollow section by using standard formula – second and product movements of plain area – rectangle ,triangle ,circle from integration – T section, I section, Angle section, Hollow section by using standard formula – parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moment of inertia of plain areas – Principal axis of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principal- Relation to area moment of inertia.

Unit-IV: Dynamics Of Particles

Displacement, Velocity and acceleration, their relationship – Relative motion Curvilinear motion – Newton's law, work energy equation of particles – Impulse and Momentum – Impact of elastic bodies.

Unit-V: Friction and Elements of Rigid Body Dynamics

Frictional force – Laws of coloumb friction – simple contact friction – Rolling resistance – Belt friction - Translation rotation of rigid bodies – Velocity and acceleration – General plane motion

TEXT BOOKS

1) Rajasekaran S and Sankarasubramanian " Engineering Mechanics"(statics andDynamics) Vikas Publishing House Pvt. Ltd, Noida, 2009
2) Palanichamy, M.S and Nagan, S, "Engineering Mechanics (Statics and Dynamics)",Tata McGraw Hill Publishing Company, Ltd., New Delhi, 2010.
3) S. S. Bhavikaati "Engineering Mechanics" New age International (P) Ltd. 2019

REFERENCES

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. Natesan,S.C, "Engineering Mechanics (Statics and Dynamics)", first edition, Umesh Publications, New Delhi, 2002.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications.

COURSE OUTCOMES

At the end, Students can able to

1. Explain the forces and its related laws of mechanics in static and dynamic conditions.
2. Analyse the forces and its motions on particles, rigid bodies and structures.
3. Solve the moment of inertia of any sections and masses for the structural members.
4. Understand the principles of kinetics and dynamics.
5. Understand the concept of particle dynamics in motion.

Mapping of COs with POs												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓									✓	✓
CO2		✓	✓	✓						✓		
CO3					✓		✓		✓			
CO4						✓			✓		✓	
CO5						✓			✓			

18EIES304	THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

- The principles of work and energy, design principles and analysis of thermo-fluid systems.
- The physical properties of fluids and their consequences on fluid flow.
- The conservation principles of mass, linear momentum, and energy for fluid flow.
- The basic forces and moments acting on simple profiles and shapes in an inviscid, steady fluid flow.

Unit – I

Fundamentals- System and control volume; state and process, Thermodynamic equilibrium, quasi-static process, Zeroth law, work and heat interaction, First law for a cycle and a process, steady flow processes, second law statements , reversibility, Carnot theorem, Clausius inequality and entropy principle.

Unit –II

Properties of pure substances- constant temperature and constant pressure heating of water ; Definitions of saturated states , P-v-T surface; Use of steam table-Identification of states and determination of properties , Mollier's chart. Rankine cycle, reheat cycle and regenerative cycle -working principle representations of process on P-v , T-s and h-s plots (Theory only).Heat engines: Otto, Diesel and Dual cycles.

Unit – III

Fundamentals of Fluid mechanics: Classification of fluids and their physical properties, Fluid statics, Manometers, Pressure on submerged bodies. Ideal fluid – velocity field – stream line , streak line and path line, continuity equation-Rotational and irrotational flow , stream function and potential function, Euler's equation of motion – Bernoulli's equation and its applications.

Unit–IV

Dimensional analysis – Rayleigh's method – Buckingham theorem and its applications. Darcy Weisbach equation – Moody's diagram, minor losses – Boundary layer and its basic concepts.

Unit – V

Fluid Machinery: Centrifugal pumps, Reciprocating pumps, Hydraulic ram, Impulse turbine and Reaction turbine.

TEXT BOOKS

1. Zemansky, Heat and Thermodynamics, 7th edition, McGraw Hill, New York, 1997.
2. Ojha C.S.P., Berndtsson R., Chandramouli P.N., Fluid Mechanics and Machinery, Oxford University Press,2010.
3. R.K. Bansal, Fluid Mechanics and Hydraulic Machinery, Lakshmi Publications.

REFERENCES

1. Van Wylen G.A., Fundamentals of classical Thermodynamics, 4thEdition, John Wiley and Sons,1994.
2. Cengal Y.A., Bogles M.A., Micheal Boles, Thermodynamics, 2nd edition, McGraw Hill Book Company, 1994.
3. Streeter V.L. and Wylie E.B., 'Fluid Mechanics', 9 th edition, McGraw Hill, New York, 1997.
4. Nag P.K., Engineering Thermodynamics, 2nd Edition, Tata McGraw Hill, 1995.
5. Crowe C.T., Elger D.F., Williams B.C., Roberson J.A., Engineering Fluid Mechanics 9th Edition, John Wiley & Sons, 2009.

COURSE OUTCOMES

By the end of this course, the students will be able to:

1. Understand the basics of thermodynamics. (Unit I)
2. Understand various thermodynamic cycles and apply them to heat engines. (Unit II)
3. Quantify the properties of fluids. (Unit III)
4. Familiarize the equations relating boundary layer and concepts. (Unit IV)
5. Know the principles of operation of some of the widely used fluid machinery.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			✓	✓	✓					✓		✓
CO2			✓		✓							✓
CO3	✓	✓			✓						✓	
CO4	✓										✓	
CO5		✓									✓	✓

18EIPC305	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- To analyze electrical circuits using KCL and KVL.
- To learn network theorems and apply them for circuit analysis.
- To study resonance and coupled circuits.
- To study transient analysis of RC, RL, RLC circuits.

Unit-I : Network Theorems

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Unit-II : Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel RL, RC, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit-III : Sinusoidal steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit-IV : Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit-V :Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

TEXT BOOKS

1. Sudhakar and Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill Education; Fifth edition, 2015.
2. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.

REFERENCES

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
2. P. Rameshbabu, “Electric Circuit Analysis”, New Scitech Publications (India) Pvt Limited, 2010.

3. Mahmood Nahvi& Joseph Edminister, "Electric Circuits", Schaum's Outline Series, McGraw Hill Education; Sixth edition, 2014.
4. R.L. Boylestad, "Introductory Circuit Analysis", 13th edition, Pearson (23 March 2015).
5. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
6. M. E. Van Valkenburg, "Network Analysis", Third Edition, Pearson Education India of India, 2015.

COURSE OUTCOMES

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits.(Unit I)
2. Obtain the transient and steady-state response of electrical circuits.(Unit II)
3. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).(Unit III)
4. Analyse two port circuit behavior.(Unit IV)
5. Acquire engineering analytic techniques and skills.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓						✓			
CO2	✓	✓	✓	✓					✓			
CO3		✓	✓	✓	✓						✓	
CO4		✓		✓	✓						✓	
CO5		✓	✓	✓					✓			✓

18EIPC306	ANALOG ELECTRONIC CIRCUITS	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- To study the qualitative and quantitative exposition of fundamental concepts of silicon and germanium semiconductor devices.
- To understand the principle, operation and characteristics of diode, bipolar junction transistor and metal oxide field effect transistor.
- To study the characteristics of operational amplifiers and its applications

Unit-I: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit-II: BJT circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.

Unit-III: MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

Unit-IV: Differential, multi-stage and operational amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit-V: Linear & Nonlinear applications of op-amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, oscillators (Wein bridge and phase shift).Hysteresis Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector, Astable Multivibrator.

TEXT BOOKS

1. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog IntegratedCircuits”, John Wiley & Sons, 2001.
2. Theodore F Bogart, Jeffrey S. Beasley, Guillermo Rico, "Electronic Devices and Circuits", Sixth Edition, Pearson Education India, 2004.

REFERENCES

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.
3. M.K. Achuthan and K.N. Bhat, “Fundamentals of Semiconductor Devices”, Tata McGraw-Hill Publishing Company Limited, 2007.
4. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
5. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
6. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill International Edition, 2001.

COURSE OUTCOMES

At the end of this course, students will be able to

1. Understand the characteristics of transistors.(Unit II)
2. Design and analyse various rectifier and amplifier circuits. (Unit I)
3. Understand the fundamental concepts of MOSFETs and their applications foranalog electronics circuits. (Unit III)
4. Understand the functioning of OP-AMP. (Unit IV)
5. Understand the design OP-AMP based circuits. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓								✓			
CO2	✓	✓	✓	✓	✓				✓		✓	
CO3	✓			✓	✓				✓			
CO4	✓	✓	✓		✓				✓		✓	✓
CO5	✓	✓	✓								✓	✓

18EISP307	FLUID MECHANICS & HYDRAULICS MACHINERY LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharged are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments in envisaged.
- To understand the significance and role of such utilities in their further course of study.

LIST OF EXPERIMENTS

1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturimeter
3. Determination of Co-efficient of Head loss due to Sudden Change in Section
4. Determination of Co-efficient of Head loss due to Friction in Pipe
5. Determination of Co-efficient of discharge of Rectangular Notch
6. Determination of Co-efficient of Impact of Jet on Vanes
7. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
8. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
9. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
10. Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
11. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
12. Study of Performance characteristics of Francis Turbine (Constant Head method)
13. Determination of Metacentric Height of a floating vessel (Demo Only)
14. Study on Flow through Open Channel (Demo Only)
15. Determine the properties of fluids, pressure and their measurements
16. Measure flow in pipes and determine frictional losses

COURSE OUTCOMES

Make the students understand

1. After completion of this course, a student will be able to:
2. Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits
3. Develop Characteristics of pumps and turbines.

18EICP308	ELECTRIC CIRCUITS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

1. To study & verify the circuit theorems practically
2. To understand the significance of the circuit theorems and their applications
3. To understand the significance of resonance conditions in series and parallel circuits

LIST OF EXPERIMENTS

1. Analysis of DC resistive circuits and verification of Kirchhoff's Laws.
2. Verification of Maximum power transfer theorem.
    a. Verification of Thevenin's theorem.
    b. Verification of Norton's Theorem.
    c. Verification of Superposition Theorem.
    d. Verification of Tellegen's Theorem.
3. Steady State sinusoidal response of RLC series circuit.
4. Analysis of DC resistive circuit using EWB software. [Study of ORCAD software (Application to circuit analysis).]
5. Experimental determination of time constant of series R-C electric circuits
6. Design and Simulation of series resonance/parallel resonance circuits.
7. Design of low pass and high pass passive filters.
8. Study of CRO and measurement of sinusoidal voltage, frequency and power factor.
9. Calibration of single phase energy meter.
10. Determination of two port network parameters.
11. Experimental determination of power in three phase circuits by two-watt meter method.

COURSE OUTCOMES

Make the students understand

1. The significance of the theorem and the practical verification of theorems.
2. The usage of the theorem in the analysis of the circuits.
3. The way of trouble shooting the circuit connection and to test the devices.
4. The circuit connections and testing points of the circuit by simulation and implementation.
5. The significance of resonance conditions in series and parallel circuits.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓		✓				✓			
CO2	✓	✓	✓		✓				✓			✓
CO3	✓		✓	✓					✓		✓	
CO4	✓		✓		✓						✓	
CO5	✓				✓							✓

18EICP309	ANALOG ELECTRONICS LAB	L	T	P
		-	-	1.5

COURSE OBJECTIVES

- To obtain the characteristics graphically of each mentioned circuit devices
- To understand the significance of the circuit devices with their applications.
- To analyse the need of each device.
- To analyse frequency response of circuit components by simulation and experimentation

LIST OF EXPERIMENTS

1. Ampere-Volt (I-V) characteristics of P-N junction semiconductor diode and Zener Diode.
2. Input and output characteristics of BJT and determination of its h-Parameters.
3. Transfer and drain characteristics of JFET and determination of its parameters.
4. Steady State sinusoidal response of RLC series circuit.
5. I-V characteristics of Silicon Controlled Rectifier.
6. Frequency response of RC coupled amplifier.
7. Simulation of simple operational amplifier configurations using Electronic Work Bench (EWB) software.
8. Design of multivibrator circuits using 555 timer IC.
9. Design of low pass and high pass filter circuits.
10. Design of precision full wave rectifier circuit.
11. Design of instrumentation amplifier circuit.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Observe the characteristics of the devices and to find various practical parameters like input impedance, trans-conductance, pinch-off voltage etc., related to their applications.
2. Understand the circuit connections and testing points of the circuit by simulation and implementation.
3. Design of various electronic circuits using the fundamental concepts for industrial applications.
4. Simulate various electronic circuits using Electronic Work Bench Software without the use of physical electronic components so that it is possible to reduce the time, energy and cost.
5. Troubleshoot the malfunctioning of electronic circuits and to identify the compatibility of system components in the design of Integrated Circuit.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓				✓			
CO2	✓	✓	✓						✓		✓	✓
CO3	✓	✓			✓			✓	✓		✓	
CO4	✓	✓		✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓			✓	✓		✓	✓

18EIBS401	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students to probability, random processes, and statistical methods designed
- To contribute them to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics - using method of finite difference interpolation, finding numerical solution of algebraic and transcendental equations, and finding numerical solution of ordinary and partial differential equations.

Unit–I : Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II : Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationarity –Autocorrelation function and its properties - cross correlation function and its properties.

Unit–III : Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV : Interpolation

Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval.

Numerical differentiation: Using Newton's forward and backward interpolation formula.

Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rule.

Unit–V :

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton–Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

TEXT BOOKS

1. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Probability and random processes, S.Chand & Co. Ltd.
2. Veerarajan. T., Probability theory and Random Process, Tata McGraw – Hill Co., Ltd. New Delhi 2005.

REFERENCES

1. Venkataraman M.K., Numerical method in science and Engineering, National publishing Co., Chennai - 2003.
2. Lipschutz..S and Schiller. J, Schaums"s outlines – introduction to probability and statistics McGraw Hill, New Delhi, 1998.
3. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Numerical Methods, S.Chand & Co. Ltd., New Delhi. 2004.

COURSE OUTCOMES

At the end of the course, the students would

1. Acquire skills in handling situations to solve problems for engineers using numerical methods.
2. Understand random variables and random processes
3. Understand numerical differentiation and integration
4. Give numerical solution for algebraic and transcendental equations.
5. Give numerical solution for ordinary differential equation.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓						✓	✓
CO2	✓	✓			✓				✓			
CO3	✓	✓	✓	✓	✓			✓	✓		✓	
CO4	✓	✓	✓	✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓			✓	✓		✓	✓

18EIES402	ELECTRICAL TECHNOLOGY	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

- To know the different types of AC and DC machines and their applications.
- To motivate the students to gain knowledge about the basic principles and the laws governing the operation of electrical measuring instruments.
- To familiarize the students about the functioning of different types of instruments.
- To understand the concepts of various measuring techniques.

Unit–I Power and Energy measurement

Power measurement – Ammeter and Voltmeter method - Electrodynamic wattmeter, errors and compensation, thermal type wattmeter, single and 3- phase power measurements.

Energy measurement - Induction type energy meter, principle, construction, errors and compensation.Calibration of wattmeters and energymeters.

Potentiometers: AC potentiometers - Drysdale potentiometer, Gall potentiometer, DC potentiometers - Leeds and Northrup potentiometer, Brooks deflection potentiometer

Unit–II AC and DC bridges

Resistance Measurement - Series and shunt type ohmmeter. Wheatstone bridge, Kelvin bridge, Megger.

AC bridges - Maxwell bridge, Wien bridge, Anderson bridge, Hays bridge, Schering bridge - Campbell bridge to measure mutual inductance - detectors in bridge measurements.

Unit–III DC Machines

Construction details of machine - operation of DC generators - EMF equation - characteristics of different types of DC generators - commutation - armature reaction - operation of DC motors - torque equation - characteristics of different types of DC motors. Starters - breaking and speed control of DC motors.

Unit–IV Induction Machines

Three phase - types - constructional features - equivalent circuit - slip - torque characteristics - starters - breaking and speed control methods. Principle of operation, types and applications of single phase induction motors.

Unit–V Magnetic circuit

Magnetomotive force - magnetic field strength - permeability of free space-relative permeability - reluctance - comparison of electric and magnetic circuits - composite magnetic circuit - magnetic leakage and fringing - Kirchoff's laws for the magnetic circuit - magnetization curve - hysteresis loop - current-ring theory of magnetism - hysteresis loss - minimum volume of a permanent magnet - load line of a permanent magnet - magnetic field of a long solenoid - magnetic energy in a non-magnetic medium - magnetic pull. Inductance of a coil and factors determining inductance of a coil.

TEXT BOOKS

1. Theraja and Theraja., A Text book of Electrical Technology - Vol.II, AC and DC Machines,23rdRevisedEdition,S.Chand&Co.,Ltd.2002.
2. A.K. Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpathRai& Co (P) Ltd, 2004.

REFERENCES

1. R.Muthusubramanian, S. Salivahanan and K.A.Muraleedharan, Basic ElectricalElectronics and Computer Engineering, Tata McGraw – Hill Publishing Company Limited, 2000.
2. I.J.Nagrath and D.P.Kothari, Electric Machines, Second Edition, Tata McGraw – Hill Publishing Company Limited, 1997.
3. J.B.Gupta, A Course in Electronic and Electrical Measurements and Instru mentation,S.KKataria & Sons, Delhi, 2003.
4. H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 2004.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the practical application of Wattmeters and Energy meters.(Unit-I)
2. Construct and determine the circuit parameters using AC and DC bridges.
3. Get the knowledge of electrical DC machines (Unit-III)
4. Understand the practical application of Induction machines.(Unit-IV)
5. Acquire knowledge on magnetic circuits. (Unit-II)

Mapping of COs with Pos												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓				✓			
CO2		✓	✓								✓	✓
CO3	✓	✓	✓		✓						✓	
CO4		✓	✓	✓	✓						✓	✓
CO5	✓		✓		✓				✓		✓	

18EIPC403	CONTROL SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To provide a sound knowledge in the basic concepts of linear control theory and design.
- To acquire knowledge in the basics of control system and its components.
- To understand the time response and frequency response analysis.
- To study about stability analysis.
- To understand the design of compensators.

Unit-I : Introduction to Control Problem

Open-Loop and Closed-loop systems: Generalized Block Diagram of a Feedback System: Benefits of Feedback-Block diagram algebra- Signal Flow Graph and the Mason's Gain Rule. Transfer function models of linear time-invariant systems-Mathematical models of physical systems -.

Unit-II : Time Response Analysis

Standard test signals-Time response of first and second order systems for standard test inputs- - steady state error and error constants- steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems..Design specifications for second-order systems based on the time-response. Proportional, Integral and Derivative Controllers.

Unit-III : Stability Analysis

Concept of stability: Necessary conditions for Stability-BIBO Stability – Routh-Hurwitz Criterion. Root locus concept: Guidelines for sketching root loci – Root locus plots for continuous-time systems. Introduction to design - lag, lead and lag-lead configurations: Effects on system response and their realization - design of cascade compensators in the time domain -Root-locus method of feedback controller design.

Unit-IV : Frequency Response Analysis

Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion-Relative stability using Nyquist criterion-gain and phase margin.Controller Design specifications in frequency domain - design of cascade compensators in the frequency domain.

Unit-V : State Variable Analysis

Concepts of state variables, State space model, Diagonalization of State Matrix-Solution of state equations- Eigen values and Stability Analysis-Concept of controllability and observability - Pole-placement by state feedback - State-space models of linear discrete-time systems.

TEXT BOOKS

1. J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New Age International (P) Ltd., Publishers, 2009.
2. M. Gopal, Control Systems Principles and Design, McGraw-Hill Education, Fourth edition, 2012.

REFERENCES

1. B. C. Kuo, Automatic Control Systems, Prentice Hall of Indian, Sixth Edition, 1991.
2. K. Ogata, Modern Control Engineering, Prentice Hall India Learning Private Limited, Fifth Edition, 2010.
3. K. Ogata, Solving Control Engineering Problems with MATLAB, Prentice Hall, 1994.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basics of control system for the design and analysis (Unit I)
2. Understand the issues related to time response analysis. (Unit II)
3. Perform frequency response and stability analysis. (Unit III)
4. Design compensators in time and frequency domain. (Unit IV)
5. Understand the concept of stability and its assessment for linear-time invariant systems.(Unit V)

Mapping Cos with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓							
CO2		✓		✓				✓	✓			
CO3		✓		✓				✓	✓			✓
CO4		✓		✓				✓	✓		✓	
CO5		✓										

18EIPC404	DIGITAL ELECTRONICS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To impart a thorough understanding of the fundamental concepts and techniques used in digital electronics.
- To gain an intuitive understanding of the role of digital logic levels and application of knowledge to understand digital logic families.
- To understand, analyze and design digital systems using combinational and sequential logic.
- To introduce the concept of memories and programmable logic devices.

Unit-I: Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit II : Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit III : Sequential circuits and systems

One-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, JK, T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit IV : A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Unit V : Semiconductor memories and Programmable logic devices.

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge decoupled

device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

TEXT BOOKS

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education India, 2016.
2. Ananda Natarajan R, Digital Design, Second edition, Eastern Economy Editions, PHI Learning Pvt. Ltd., 2015.

REFERENCES

1. A.Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.
3. M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. S.Salivahanan and S. Arivazhagan, Digital Circuits and Design, Fourth Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.
5. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, Sixth Edition, Tata McGraw Hill, 2003.
6. John F Wakerly, "Digital Design:Principles and Practices", Third Edition, Pearson Education India, 2016.

COURSE OUTCOMES

At the end of this course, students be able to

1. Understand working of logic families and logic gates.(Unit I)
2. Design and implement Combinational logic circuits. (Unit II)
3. Design and implement Sequential logic circuits (Unit III)
4. Understand the process of Analog to Digital conversion and Digital to Analog conversion. (Unit IV)
5. Be able to use PLDs to implement the given logical problem.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓										✓
CO3		✓									✓	✓
CO4		✓	✓								✓	
CO5		✓	✓								✓	✓

18EIPC405	ELECTRONIC INSTRUMENTATION AND MEASUREMENT TECHNIQUES	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To introduce different types of electronic meters, different types of waveform generators, analyzers.
- To provide knowledge of digital instruments, intelligent instruments, cathode ray oscilloscope, other display devices & their applications.
- To introduce different types of recorders and to educate interference and screening.
- To introduce computer controlled system and to give exposure on virtual instrumentation.

Unit–I : Measurement of Voltage and Current

Electronic analog meters: DC and AC voltmeters - true R.M.S. voltmeters - differential voltmeters - a.c. current measurements – analog multimeters.

Component measuring instruments

Q-meter - vector impedance meter - Power meter.

Signal sources and Wave analyzers

Basic standard Signal generator (sine wave) – Square and pulse generator, Sweep generator. Wave analyzer - harmonic distortion analyzer- spectrum analyzer.

Unit–II : Digital Measurements

Digital methods of measuring frequency, period, phase difference, pulse width, time interval, total count, AC and DC voltage and current, true r.m.s voltage. DMM, DPM. Comparison between analog and digital techniques of measurement.

Introduction to intelligent instruments. Digital displacement transducers, incremental and absolute types – measurement of velocity, acceleration- Moire fringe transducer.

Unit–III : Oscilloscope and Display devices

Cathode Ray oscilloscopes: Block diagram of oscilloscope - CRT screen characteristics - vertical, horizontal amplifiers, input coupling - time base: synchronization, free run, auto and single sweep modes – multiple trace display: alternate, chop, X-Y modes of operation - sweep trigger sources, coupling - delayed sweep, delay lines. Special probes - high frequency considerations- Sampling oscilloscope - digital storage oscilloscope. Specifications of DSO-Typical measurements using CRO and DSO.

LED, LCD – annunciators, numeric, alphanumeric, graphics.

Unit–IV : Recorders and Interference Effects

Recorders - moving coil, potentiometric, event recorders - X-Y plotters - U.V. recorders - digital recording.

Interference and screening - component impurities and their effects on signals - electrostatic and electromagnetic interference - multiple earths and earth loops.Practical aspects of interference reduction.

Unit–V : Computer Controlled Test Systems and Virtual Instrumentation

Computer-Controlled test Systems: Testing an audio amplifier - Instruments used in Computer Controlled Instrumentation - IEEE Electrical Interface and Specifications - Block Diagram of an IEEE-488 bus Connected System and Digital Control Description.

Virtual Instrumentation: Definition, flexibility – Block diagram and architecture of virtual instruments – VI vs traditional instruments. Software in virtual instrumentation. Instrument Control - Instrument Drivers - VXI Bus.

TEXT BOOKS

1. A.K.Sawhney, A course in Electrical & Electronic measurements & Instrumentation, Dhanpat Rai & co., 2013.
2. W.D.Cooper and A.D.Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall of India, 2009.

REFERENCES

1. H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 1995.
2. A.J.Bouwens, Digital Instrumentation, McGraw Hill, 2001.
3. LabVIEW basics, Vol.1&2 manuals, National Instruments, 2006.
4. D.F.A.Edwards, Electronic measurement techniques, Elsevier, 2014.
5. George.C.Barney, Intelligent Instrumentaion, Prentice Hall of India, 1998.
6. Jovitha Jerome, VI using LabVIEW, Prentice Hall of India, 2010.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand different types of electronic meters and their applications. (Unit I)
2. Understand different types of waveform generators, analyzers and their applications. (Unit I)
3. Understand digital instruments and intelligent instruments. (Unit II)
4. Gain knowledge of cathode ray oscilloscope, recorders and other display devices with their applications. (Unit III & IV)
5. Understand computer controlled system and virtual instrumentation. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓	✓									✓	
CO3	✓	✓									✓	
CO4	✓	✓									✓	
CO5	✓	✓	✓	✓	✓						✓	✓

18EIPC406	TRANSDUCERS AND MEASURMENT SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To learn about the science of measurement system and its properties.
- To acquire knowledge about characteristics of measurement systems subjected to time invariant and time variant inputs .
- To understand the principle and characteristics of resistive, capacitive and inductive transducers.
- To study about characteristics and applications of fiber optics, MEMS based transducers and transducers governed by other principles such as hall effect and piezo electric effect.

Unit–I : Science of Measurements

Methods of measurement - Generalized scheme of a measurement system - Errors in measurement - types of errors- limiting error-probable error- Statistical analysis of measurement data – mean and standard deviation- Probability of errors - Gaussian distribution- Reliability of measurement systems.

Unit–II : Performance Characteristics

Static and dynamic characteristics of measurement system - transfer function – characteristics of zero, first and second order type of instruments - impulse, step, ramp and frequency responses of the above types of instruments.

Unit–III : Resistance Transducers

Transducer- Difference between sensor and transducer- basic requirements of a transducer-classification of transducers-selection of transducer.

Resistance potentiometer – types of potentiometers - Loading effect – strain gauges - gauge factor - types of strain gauges - strain measuring circuits – temperature compensation and error cancellation techniques in strain measurement system.

Principle of RTD, Thermocouple and Thermister- Hot wire anemometer - constant current and constant temperature operation.

Unit–IV : Capacitance and Inductance Transducers

Capacitive transducers - variable area type - variable air gap type - variable permitivity type - signal conditioning circuit- capacitor microphone.

Variable inductance and Variable reluctance transducers – LVDT – RVDT - Eddy current non contacting transducers.

Unit–V : Other Types of Transducers

Introduction to fibre optic sensors -types of configurations-application in temperature, pressure, flow and displacement measurements. Hall effect transducers - IC sensor for temperature and pressure measurement-Piezoelectric transducers - piezoelectric crystals, Charge amplifier-Silicon Micro sensors-Smart sensors-characteristics and applications.

TEXT BOOKS

1. E.O.Doeblin, Measurement Systems, Application and Design, McGraw-Hill, 1998.
2. A.K. Sawhney, A course in Electrical and Electronics measurement and instrumentation, Dhanpatrai and sons, 1996.

REFERENCES

1. John B.Bentley, Principles of Measurment Systems, Longman Publishers, 2000.
2. R.K Jain, Mechanical and Industrial Measurement, Khanna Publishers, 1990.
3. D. Patranabis, Sensors and Transducers, Prentice Hall of India, 2nd edition, 2003.
4. B.C.Nakra and K.K Chaudhry, Instrumentation measurement and analysis, TMH, Third edition, 2009.

5. D.A. Krohn, Fiber Optic Sensors – Fundamentals and Applications, ISA publication, 2nd edition, 1992.
6. J.B Gupta, A course in Electronics and Electrical measurements and instrumentation, S.K.Kataria & Sons, New Delhi, Fifth Edition, 2010.

COURSE OUTCOMES

At the end of the course the students will be able to

Select a measurement system to meet the requirements. (Unit I)

Knowledge about characteristics of system based on the type of input. (Unit II)

Choose among the various types of resistance transducers for particular application.(Unit III)

Choose among the various types of capacitive and inductive transducers depending on the principle, range, cost and commercial availability. (Unit IV & V)

Understand the recent trends in the development of transducers and the engineering involved in it. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓										✓	
CO2	✓	✓	✓								✓	
CO3	✓	✓	✓								✓	✓
CO4	✓		✓	✓							✓	✓
CO5	✓		✓	✓							✓	✓

18EICP407	CONTROL SYSTEMS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To understand the different methods of system representation and obtain the model of the system in time and frequency domains.
- To impart necessary knowledge in the time domain response and steady state response.
- To give basic knowledge in obtaining the open loop and closed loop time and frequency responses.

LIST OF EXPERIMENTS

1. Determination of transfer function of a DC Servomotor and its speed control.
2. Solving Control Engineering problems using MATLAB software.
3. Study of DC Position control system.
4. Design and implementation of a Phase Lead Compensator using MATLAB software.
5. Identification of a given system using frequency response characteristics.
6. Characteristics of Sample and Hold circuit.
7. Simulation of a Sampled data control system.
8. Sensitivity analysis of open loop and closed loop systems using Process Control Simulator.

9. Stability characteristics of feedback systems using Process Control Simulator.
10. Time response analysis of a Second order type-0 and type-1 system using Process Control Simulator.

COURSE OUTCOMES

After successful completion of this course, the students should be able

1. To identify the model of any system using various techniques and investigate its performances in open and closed loops.
2. To obtain desired performance by designing and implementing suitable compensators for the taken up system.
3. To identify any type of control system with respect to system stability in time domain as well as frequency domain.
4. To understand the concept of sensitivity and stability characteristics of open loop and closed loop control systems.
5. To obtain the time response analysis of type-0 and type-1 systems.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓						✓	
CO2	✓	✓	✓									
CO3	✓	✓	✓								✓	✓
CO4	✓	✓			✓						✓	✓
CO5	✓	✓	✓								✓	✓

18EICP408	DIGITAL ELECTRONICS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- Simplification of complex logic functions using reduction techniques.
- Design of analog and digital electronic circuits for industrial applications.
- Study of Electronic Work Bench Software to simulate various electronic circuits.
- Identification of malfunctioning of circuits/components and to troubleshoot the same.

LIST OF EXPERIMENTS

1. Verification of logic gates using integrated circuits.
2. Simplification of logic expressions using Karnaugh map techniques.
3. Implementation of half adder and full adder circuits using logic gates.
4. Design and Realization of one bit, two bit and magnitude comparators.
5. Design and verification of parity generator circuits.
6. Design and verification of electronic pendulum circuit.
7. Design and simulation of 3 bit synchronous counter usig EWB software.
8. Implementation of Digital to Analog converter.
9. Verification of Multiplexer/Demultiplexer.
10. Implementation of i) priority encoders and ii) LED decoder driver circuit.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Test and understand the logic gates using their truth tables which is very useful in the design of Integrated Circuits.
2. Simplify the complex logic function into simplest one so that it is possible to reduce the size of the circuit.
3. Design of various electronic circuits using the fundamental concepts in digital electronic systems for various industrial applications.
4. Simulate various electronic circuits using Electronic Work Bench Software without the use of physical electronic components so that it is possible to reduce the time, energy and cost.
5. Troubleshoot the malfunctioning of electronic circuits and to identify the compatibility of system components in the design of Integrated Circuit.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2		✓	✓		✓						✓	✓
CO3		✓	✓		✓							✓
CO4		✓	✓	✓	✓						✓	✓
CO5	✓										✓	✓

18EICP409	**SENSORS AND SIGNAL CONDITIONING LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To familiarize the students with principle and characteristics of various transducers.
- To design and implement signal conditioning circuits for temperature, pressure and displacement.
- To impart knowledge about the design and implementation of analog and digital filters using Matlab software
- To learn the design and development procedure for V/I and I/V convertors and implementation using EWB software.

LIST OF EXPERIMENTS

1. Characteristics of Potentiometer and Potentiometer as error detector.
2. Characteristics of Synchro and application of Synchro as error detector.
3. Simulation of signal conditioning circuit for LVDT.
4. Design of Analog and Digital filters using MATLAB software.
5. Characteristics and Transfer function of RTD and Thermocouple.
6. Design, construction and testing of a signal conditioning circuit for temperature Measurement using RTD.
7. Simulation of Voltage to Current converter and its practical implementation.
8. Simulation of Current to Voltage converter and its practical implementation.
9. Measurement of pressure using strain gauge.
10. Design and testing of signal conditioning circuits using EWB software.

COURSE OUTCOMES

At the end of the practical course the students will be able to

1) Select and use the proper transducer for the required application.
2) Have a knowledge of characteristics of various sensors
3) Obtain the Transfer function model for sensors
4) Design and implement signal conditioning circuits for process variables such as temperature, pressure and displacement.
5) Apply the MATLAB and EWB software packages for the design and verification of signal conditioning circuits.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓						✓	
CO2	✓	✓	✓		✓							
CO3	✓		✓	✓	✓						✓	✓
CO4	✓	✓	✓					✓		✓	✓	✓
CO5	✓	✓		✓							✓	

18EIPC501	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand load cell, strain gauge and torque measurement.
- To understand pressure measuring devices like Manometers, Bourdon gauge and vacuum pressure measurement.
- To analyze the concept of temperature sensors like RTD, Thermocouple and Pyrometers.
- To study the variable head type and variable area type flow meters.
- To understand air purge system and boiler drum level measurement.

Unit–I : Measurement of Force, Torque and Speed

Electric balance - Load cell - Hydraulic, Pneumatic, strain gauge-Magnetoelastic and Piezoelectric load cells - Torque measurement- Relative angular twist-Speed measurement-Capacitive tacho-Drag cup type tacho-D.C and A.C tachogenerators - Stroboscope.

Unit–II : Pressure Measurement

Units of pressure - Manometers, different types, Elastic type pressure gauges, Bourdon tube, bellows and diaphragms - Electrical methods- Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum-McLeod gauge-Thermal conductivity gauge-Ionization gauges - Cold cathode type and hot cathode type - Calibration of pressure gauges - Dead weight tester.

Unit–III : Temperature Measurement

Definitions and standards - Primary and secondary fixed points - Calibration of thermometers - Different types of filled in system thermometers - Sources of errors in - filled in systems and their compensation - Bimetallic thermometers - RTD -

characteristics and signal conditioning-3 lead and 4 lead RTDs – Thermistors-Thermocouples - Laws of thermocouple- Commercial circuits for cold junction compensation - Response of thermocouple, Radiation methods of temperature measurement - Total radiation pyrometers - Optical pyrometers.

Unit–IV : Flow Measurement

Expression for flow rate through restriction -Orifice plate – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube - averaging pitot tube – installation and applications of head flow meters - Positive displacement flow meters – Nutating disc, Reciprocating piston and Oval gear flow meters – Turbine flow meter – Variable Area flow meter– Rotameter – Mass flow meter - Coriolis type mass flow meters – Calibration of flow meters- Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

Unit–V : Level Measurement

Float gauges - Displacer type – Air purge level system – Electrical types – Conductivity level sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement – Hydrastep method - Solid level measurement.Miscellaneous Measurement:Viscosity - Saybolt viscometer-Rotameter type viscometer, Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell –Moisture – Moisture measurement in solids-Conductivity sensor.

TEXT BOOKS

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

REFERENCES

1. E.O.Doebelin and D. N.Manik, Measurement Systems -Application and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
2. A.K. Sawhney and Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation and Control, Dhanpat Rai & Sons, New Delhi, 1997.
3. D.P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 1990.
4. B.G. Liptak, Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.
5. R.K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.

COURSE OUTCOMES

At the end of the course the student attains the

1. Ability to understand Load cell, strain gauge, Speed measurement (Unit I)
2. Ability to understand and apply Manometers, Bourdon tube, Mcleod gauge, Piezo resistive, Ionization gauge, dead weight tester to pressure measurement. (Unit II)

3. Ability to understand temperature sensors like thermometers, RTD, thermistors, thermocouple and pyrometers. (Unit III)
4. Ability to understand and apply variable head type, variable area type flow meters, electromagnetic, ultrasonic, laser Doppler and solid type to flow measurement. (Unit–IV)
5. Ability to understand level sensors like float type, air purge, Capacitive, Nucleonic and Ultrasonic gauge, boiler drum level and viscosity, humidity and moisture measurement. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓							✓		
CO3	✓	✓	✓									
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									

18EIPC502	SIGNALS AND SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To learn about continuous and discrete time signals and system properties.
- To acquire knowledge about the analysis of continuous and discrete time systems.
- To understand the need for frequency transformation and to learn the difference between various representations for continuous and discrete time signals.

Unit-I : Introduction to Signals and Systems

Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit-II : Behavior of continuous and discrete-time LTI systems

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems.System representation through differential equations and difference equations.State-space Representation of systems.State-Space Analysis, Multi-input, multi-output representation.State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit-III : Frequency Domain Analysis of Continuous time signals and systems

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality.

Unit-IV : Analysis of Discrete time signals and systems

The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit-V : Sampling and Reconstruction

The Sampling Theorem and its implications.Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects.Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

TEXT BOOKS

1. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
2. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.

REFERENCES

1. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
2. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
3. P. Lathi, “Linear Systems and Signals”, OxfordUniversity Press, 2009.
4. P.RameshBabu and R.Ananda Natarajan: Signals and Systems, Scitech Publications(India) Pvt. Ltd, Fourth Edition, Chennai 2010.
5. Sanjay Sharma, Signals and Systems, Seventh Edition, S.K.Kataria & Sons New Delhi, 2011.

COURSE OUTCOMES

At the end of this course, students will be able to

1. Understand the concepts of continuous time systems (Unit I)
2. Understand the concepts of discrete time systems.(Unit II)
3. Analyse continuous time systems in complex frequency domain.(Unit III)
4. Analyse discrete time systems in complex frequency domain.(Unit IV)
5. Understand sampling theorem and its implications. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓								✓		✓	
CO2	✓	✓							✓			
CO3	✓	✓	✓						✓			
CO4	✓	✓	✓						✓			✓
CO5	✓	✓	✓							✓		

18EIPC503	PROCESS CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To introduce the dynamics of various processes and modelling of physical process using first principles.
- To educate the effect of various control actions and the methods of tuning the controller.
- To study about the construction, and characteristics of control valves.
- To introduce the concept of various complex control schemes.

Unit–I : Mathematical Modelling of Processes

Process variables – degrees of freedom – mathematical model of first order liquid process, gaseous process, flow process, thermal process, mixing process – batch process and continuous process – self-regulation – inverse response.

Unit–II :Controllers and Final Control Elements

Characteristics of On-Off, proportional, single speed floating, integral and derivative control modes – composite control modes – P+I, P+D and P+I+D control modes – response of controller for different types of test inputs – integral windup – auto/manual transfer – Non linear PID Controller – selection of control mode for different processes – typical control schemes for level, flow, pressure and temperature.

Control valve – characteristics of control valves – valve positioned.

Unit–III :Optimum Controller Settings

Tuning of controllers by process reaction curve method – continuous cycling method – damped oscillation method – Ziegler-Nichol's tuning – 1/4 decay ratio.

Feed Forward control – Ratio control – Cascade control – Averaging control.

Unit–IV :Piping and Instrumentation Diagram

Piping and Instrumentation Diagram of control loops. Complete air–supply system for pneumatic control equipment – major components and their functions.

Instrument line symbols- General Instrument Symbols-General function symbols-SAMA diagramming system-ISA instrumentation diagramming symbols-Examples of SAMA instrumentation diagramming symbols - Example of P&ID of temperature, level, flow control systems

Unit–V : Case Study

Distillation column – control of top and bottom product compositions – reflux ratio – control of chemical reactor – control of heat exchanger. Steam boiler-drum level control and combustion control. Complete air–supply system for pneumatic control equipment – major components and their functions.

TEXT BOOKS

1. George Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, First edition, Prentice Hall of India, 2008.
2. D.R. Coughanowr and Steven LeBlanc, “Process Systems Analysis and Control”, Third Edition, McGraw Hill, 2009.

REFERENCES

1. Donald P Eckman, “Principles of Industrial Process Control”, Second Edition, J. Wiley & sons, 1965.
2. Peter Harriott, “Process Control”, First Edition, Tata McGraw-Hill Education, 2001.
3. M. Gopal, “Control Systems: Principles and Design”, Fourth Edition, Tata
4. McGraw Hill, 2012.
5. TUTSIM Simulation Language Manual, TUTSIM Products Ltd., U.S.A.
6. K.Krishnasamy and M.PonniBala, Power Plant Instrumentation, PHI,
7. Second edition, 2013

COURSE OUTCOMES

At the completion of this course, students will be able to:

1. Understand basic principles and importance of process control in industrial process plants.(Unit I)
2. Acquire knowledge of dynamic modeling, system behavior and tuning of controllers. (Unit II)
3. Specify the required instrumentation and final control elements to ensure well-tuned control. (Unit III)
4. Gain the knowledge of Piping and Instrumentation Diagram (Unit IV)
5. Apply the control system in various complex processes. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2		✓	✓	✓							✓	
CO3		✓	✓	✓							✓	
CO4		✓	✓	✓								✓
CO5	✓	✓	✓	✓	✓							✓

18EIPC504	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study the architecture of 8085 microprocessor and its programming.
- To learn the design aspects of I/O and memory interfacing circuits.
- To study interfacing devices like 8255, 8253, 8259 and 8251
- To study the architectures of 8051 microcontroller.
- To learn about the 8085 and 8051 based applications.

Unit–I : 8085 Microprocessor

Microprocessor architecture and assembly language - Organization of 8085 microprocessor – memory and I/O devices -Memory mapping-Memory interfacing-Instructions set-Instruction format, Addressing modes, counters and time delays - Stack – subroutine - interrupts - Assembly Language Programming.

Unit–II : Peripherals

8255 programmable peripheral interface - 8253 programmable interval timer-8259 programmable interrupt controller - direct memory access (DMA) and 8257

DMA controller -8279 programmable keyboard display interface -8251 and serial I/O and data communication.

Unit–III : 8051 Microcontroller

Microcontrollers Vs Microprocessors – 8051 Architecture – memory organization - register bank and stack-Special function register(SFR's)-Instruction set - Addressing Modes - Assembly language programming.

Unit–IV : 8051 Peripherals

I/O port programming – Timer programming – serial port programming – Interrupt programming –Interfacing to external memory – keyboard interfacing – ADC,DAC and sensor interfacing.

Unit–V : Applications of Microprocessor and Microcontroller

Stepper motor control- DC motor position/speed measurement and control- Data transfer between two Microprocessor/Microcontrollers- Interfacing LCD display – Temperature ON/OFF control – Traffic light control.

TEXT BOOKS

1. Ramesh Gaonkar, Microprocessor Architecture Programming and Application with the 8085/8080a, Fifth edition, Penram International Publishing (India), 2011.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi,Rolin D.Mc Kinlay "The 8051 Microcontroller and Embedded Systems", PHI Learning, 2011.

REFERENCES

1. Badri Ram, Fundamentals of Microprocessor and MicroComputer, Dhanpat Rai and Sons, 1988.
2. Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming & Applications, Penram International Publishing (India), Mumbai, 1996.
3. 16 Bit Embedded Controllers Hand Book,Intel Corporation, New York, 1990.
4. Mazidi and D.MacKinlay, 8051 Microcontroller and Embedded Systems using Assembly and C, 2006 Pearson Education Low Price Edition.
5. A.Nagoor Kani, Microprocessors and Microcontrollers, First Edition Jan 2005, RBA Publications.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Learn basic concept of microprocessor and architecture nd implement programs on 8085 microprocessor. (Unit I)
2. Design of peripheral interfacing circuits. (Unit II)
3. Understand architecture of microcontrollers and develop simple assembly language progarm. (Unit III)
4. Programming the on-chip peripherals of microcontroller. (Unit–IV :)
5. Understand the recent trends and make use of microprocessor and microcontroller for different applications. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓							✓			✓	
CO3	✓	✓						✓		✓		
CO4	✓							✓			✓	
CO5	✓			✓				✓				✓

18EICP507	INDUSTRIAL INSTRUMENTATION LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To study the characteristics of convertors, square root extractor and transmitters
- To design and implement ON/OFF control, single speed floating control and averaging control
- To study the P&I diagram
- To study pneumatics
- To design and implement pH measurement system
- To linearize thermocouple using LABVIEW software

LIST OF EXPERIMENTS

1. Study of characteristics of I/P and P/I convertors.
2. Study of characteristics of Square root extractor.
3. Design and implementation of ON/OFF temperature control system.
   (a) Characteristics of Single speed floating control.
   (b) Study of P & I Diagram
4. Characteristics of strain measurement system using cantilever beam set up.
   (a) Design & simulation of Averaging Control.
   (b) Study of Pneumatics.
5. Determination of characteristics of capacitive level transmitter.
6. Design and Determination of characteristics of temperature transmitter.
7. Design and implementation of pH measurement system.
8. Study of Linearization of Thermocouple using Lab View.

COURSE OUTCOMES

1. Ability to design components of control system like transmitters, convertors and controllers
2. Ability to analyze and design the characteristics of ON/OFF, single speed floating and averaging control.
3. Ability to design signal conditioning circuits.
4. Ability to use both software and hardware tools.
5. Familiarize with the linearization of sensors and transducers

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2	✓	✓	✓							✓		✓
CO3	✓	✓	✓									
CO4				✓							✓	
CO5	✓		✓									✓

18EICP508	PROCESS CONTROL LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To impart knowledge about the modelling principle of level process and the characteristics of final control element and Controller.
- To design and implement tuning techniques of PID controller and verify in Matlab/Simulink environment.
- To design and implement closed loop control for processes like Air temperature, Air flow and Level.
- To familiarize the students with design and simulate cascade control for the given process.
- To study the applications of Programmable Logic Controller.

LIST OF EXPERIMENTS

1. Modelling and simulation of a Level process using TUTSIM.
   (a) Study of Control Valve characteristics.
   (b) Study of P&I Diagram
2. Controller tuning using Process Reaction Curve method.
3. Determination of characteristics of a PID controller using Matlab (Simulink) software.
4. Design and simulation of Cascade control system using Matlab (Simulink) software
5. Determination of Transfer function (Experimental model) of Level process.
6. Controller tuning using Continuous Cycling method.
7. Control of Air flow Process.
8. Design and Implementation of P and PI controller for an Air temperature control system.
9. Study of Programmable Logic Controller and its applications.

COURSE OUTCOMES

At the end of the practical course the students will be able to

1. To model and design controllers for different processes.
2. To design and implement advanced control techniques.
3. Familiarize with TUTSIM and MATLAB software for process control applications.
4. Familiarize with PLC software and its applications for process control operations
5. To design and implementation of control techniques for various process control applications

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓						✓		✓	
CO3				✓								
CO4		✓						✓				
CO5	✓											✓

18EICP509	MICROPROCESSOR LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To become familiar with the architecture and Instruction set of Intel 8085 microprocessor.
- To provide practical hands on experience with Assembly Language Programming.
- To provide solid foundation on interfacing the external devices to the 8085 microprocessor according to the user requirements and solutions for the real time problems.

LIST OF EXPERIMENTS

1. Multiplication by repeated addition and subtraction.
2. Multibyte Decimal addition and subtraction.
3. Code conversion.
4. Finding Smallest/Largest number from an Array of 'n' numbers.
5. Sorting an array of numbers in Ascending/Descending order.
6. Block movement of data.
7. Interrupt using RST 5.5.
8. Switches and LED Interface.
9. ADC and DAC Interface with microprocessor.
10. 8253 Timer Interface.
11. 8259 programmable Interrupt controller.
12. Kit to Kit data transfer using USART 8251.
13. Stepper motor Interface.

COURSE OUTCOMES

Understand the architecture of 8085.

1. Familiarize with the assembly level programming and impart the knowledge about the instruction set.
2. Work with standard microprocessor interfaces like Timers, Programmable peripheral interface, Programmable Interrupt controller, serial ports, digital-to-analog converters and analog-to-digital converters etc.
3. An in-depth knowledge of applying the concepts on real- time applications.
4. Interfacing devices with PC using assembly language programming

	Mapping of COs with POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓		✓	✓	✓						
CO2		✓		✓	✓	✓						✓
CO3		✓		✓	✓	✓				✓	✓	
CO4		✓		✓	✓	✓			✓			
CO5												✓

18EIPC601	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	-	-	3

Course Objectives

- To learn about discrete time signals and system properties.
- To acquire knowledge in the design of digital filters.
- To understand the need for frequency transformation and to implement the same by efficient computational algorithm.

Unit-I : Discrete-time signals and systems

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Unit-II : Z-transform

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using Z transform,Properties of Z-transform for causal signals, Interpretation of stability in Z-domain,Inverse Z-transforms.

Unit-III : Discrete Fourier Transform

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit-IV : Design of Digital filters

Design of FIR Digital filters: Window method, Park-McClellan's method - Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters.

Effect of finite register length in FIR filter design - Parametric and non-parametric spectral estimation.- Introduction to multi-rate signal processing.

Unit-V : Applications of Digital Signal Processing

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

TEXT BOOKS

1. Mitra S. K., "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing - Principles, Algorithms and Applications", Fourth Edition, Pearson India, 2007.

REFERENCES

1. Oppenheim A.V and Schaffer R.W, "Digital Signal Processing", First edition, Prentice HallIndia, 2015.
2. Ludeman L.C, "Fundamentals of Digital Signal Processing", First edition, Wiley India, 2009.
3. Emmanuel C. Ifeachor and Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Second edition, Pearson Education, 2002.
4. Johnson J.R, "Introduction to Digital Signal Processing", First edition, Prentice Hall of India, New Delhi, 2009.
5. P.Ramesh Babu, "Digital Signal Processing", Sixth edition, Scitech Publications, 2014.

Course OutComes

At the end of the course the students will be able to

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.(Unit I)
2. Analyze discrete-time systems using z-transform.(Unit II)
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.(Unit III)
4. Design digital filters for various applications.(Unit IV)
5. Apply digital signal processing for the analysis of real-life signals.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓							✓	✓		✓
CO2	✓	✓			✓							
CO3	✓	✓		✓	✓							
CO4	✓	✓		✓	✓				✓		✓	
CO5	✓	✓		✓					✓			✓

18EIPC602	INSTRUMENTATION SYSTEM DESIGN	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To impart knowledge about the design methods using orifice and rotameter type of flow transducers for flow control system.
- To understand the basics of transmitter, design principles of signal conditioning circuits for RTD and thermocouple based temperature transmitter, methods of designing cold junction compensation circuit for thermocouple.
- To study about the design of bourdon tube for the measurement of pressure and factors governing its sensitivity and to learn the design procedures of air purge pressure measurement system.
- To learn the principle behind PID controllers and the design aspects for various types of control systems.
- To understand the principle and characteristics of control valves, positioners and pumps and the design criteria involved.
- To study about the design features of alarm circuits, interlocks and micro processor based data acquisition and implementation of PID control system.

Unit–I

Analog and Digital signal conditioning – signal level and bias changes – linearization – conversion -filtering and impedance matching – concept of loading – Op-Amp circuits in instrumentation- design specifications of ADC, DAC – sample and hold circuit.

Unit–II

Orifice meter - design of orifice for given flow condition - design of rotameter - design of signal conditioning circuit for RTD based temperature transmitter - design of cold junction compensation circuit for thermocouple based temperature

transmitter - zero and span adjustment in D/P transmitters and temperature transmitters.

Unit–III

Bourdon gauges - factors affecting sensitivity - design of Bourdon tube -design of Air purge system for level measurement. Electronic P+I+D controllers - design - adjustment of setpoint, bias and controller settings.

Unit–IV

Control valves - design of actuators and positioners - types of valve bodies - valve characteristics - materials for body and trim - sizing of control valves - selection of body materials and characteristics of control valves for typical applications. Types of pumps - pipe work calculation - selection of pumps. I/P and P/I converters- complete air supply system for pneumatic control equipments.

Unit–V

Design of logic circuits for alarm and annunciator circuits, interlocks-annunciator sequences - design of microprocessor based system for data acquisition - design of microprocessor based P+I+D controller.

TEXT BOOKS

1. C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India, 8th Edition, 2015.
2. N.A.Anderson, Instrumentation for Process Measurement and Control, Berlin: Springer, 3rd Edition, 2000.

REFERENCES

1. D.M.Considine, Process Instruments and Controls Handbook ,McGraw-Hill., 5th Edition, 1997.
2. R.H.Warring, Pumping Manual, Gulf Publishing Co., 1984.
3. J.P.Bentley, Principles of Measurement Systems, Pearson Education Asia Pvt. Ltd., New Delhi, 3rd Edition, 2000.

COURSE OUTCOMES

At the end of the course the student attains the

1. Ability to design signal conditioning circuit for Instrumentation systems.(Unit I)
2. Ability to design and develop flow measurement system using orifice & rotameter and to design signal conditioning circuit for temperature transmitters using RTD & thermocouple. (Unit II)
3. Ability to design and develop air purge type of level measurement system and to design electronic PID controllers. (Unit III)
4. Ability to design and select control valves and pumps for typical control applications. (Unit–IV :)
5. Ability to design alarm circuits, interlocks & the ability to develop microprocessor based data acquisition system and PID control system. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓		✓					✓		✓
CO2	✓	✓	✓									
CO3	✓	✓	✓								✓	
CO4	✓	✓	✓									
CO5	✓	✓	✓							✓		✓

18EICP607	INSTRUMENTATION SYSTEM DESIGN LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To impart knowledge about the implementation of Auto/Manual switch in PID controller.
- To study and implement anti-reset windup scheme and various practical forms of PID controller
- To design and implement an electronic PID controller
- To design and implement signal conditioning circuits for various process.
- To learn the design and development procedure of cold junction compensation scheme using RTD

LIST OF EXPERIMENTS

1. Implementation of Auto/Manual switch in PID controller
2. Design of an Annunciator circuit using PLC
3. Implementation of anti-reset windup scheme
4. Implementation of practical forms of PID controller
5. Design and implementation of electronic PID controller
6. Realization of first order and second order systems with dead time using electronic circuits
7. Design and implementation of cold junction compensation scheme using RTD
8. Design and simulation of two position controller for a Thermal process
9. using Electronic Work Bench (EWB) software
10. Design of Alarm circuit using Logic gates.
11. Design of Signal conditioning circuit for the given process
12. Design of control valve sizing
13. Design of an orifice

COURSE OUTCOMES

At the end of the practical course the students will be able

1. To implement the Auto/Manual switch in PID controller
2. To design practical forms of PID and anti reset windup scheme.
3. To design and implement electronic PID controller
4. To familiarize with cold junction compensation for Thermocouple using RTD.
5. To design of process control components

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓				✓			✓
CO2	✓	✓		✓	✓				✓			
CO3	✓	✓		✓	✓				✓			
CO4			✓		✓						✓	
CO5	✓			✓	✓					✓		

18EICP608	SIGNAL PROCESSING AND EMBEDDED SYSTEMS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To understand the basic concepts of embedded system
- To become familiar with the architecture and Instruction set of Intel 8051 and PIC microcontroller.
- To develop skill in simple program writing for 8051 and PIC microcontroller
- To develop and demonstrate how to accomplish a given task using Assembly and "C" language on a microcontroller
- To familiarize the interfacing of various peripheral devices with 8051 and PIC microcontroller.

LIST OF EXPERIMENTS

1. Implementation of arithmetic operations using TMS 320F/C240 Digital signal processor.
2. Matlab simulation of discrete signals in time domain and frequency domain representation.
3. Design and Matlab implementation of FIR and IIR filter using windowing techniques.
4. Arithmetic Exercises in 8051 using RIDE package (Assembly Language Program).
5. Simple programs in PIC Microcontroller using MPLAB.
6. Interfacing switches and LED with 8051 Microcontroller.
7. Interfacing Push button and Buzzer with 8051 Microcontroller.
8. Programming the on-chip Timer of 8051 Microcontroller.
9. Stepper motor control using 8051 Microcontroller.
10. Programming the on-chip ADC and PWM of PIC Microcontroller using MPLAB.
11. Implementation of Logic Gates and MUX/DEMUX in FPGA.

COURSE OUTCOMES

1. Understand the architecture of 8051 and PIC microcontroller.
2. Familiarize with the assembly level programming, Embedded C and impart the knowledge about the instruction set.
3. Develop software for embedded system using Cross compliers like RIDE , MPLAB.
4. Students will have the knowledge through hands-on experimentation the Xilinx tools for FPGA.
5. Design as well as the basics of VHDL to design, simulate and implement the digital systems.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓						✓	✓
CO2		✓			✓				✓			
CO3		✓	✓	✓	✓					✓		✓
CO4			✓	✓	✓						✓	
CO5			✓	✓	✓				✓			

18ETHS701	ENGINEERING ETHICS	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering.
- To take balanced decisions.

Unit–I

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit–II

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit–III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

Unit–IV

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit–V

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TEXT BOOKS

1. Govindarajan, M., Natarajan, S. and Senthilkumar, V.S., "Professional Ethics And Human Values", PHI Learning, New Delhi, 2013.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.

REFERENCES

1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
2. Charles D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics for Scientists and Engineers", OxfordUniversity Press, 2001.
4. David Ermann and Michele S. Shauf, "Computers, Ethics and Society", OxfordUniversity Press, (2003).

COURSE OUTCOMES

1. Understand the relationship between the engineer and the society.
2. Learn the importance of codes in engineering practice.
3. Acquire knowledge on the legal, moral and ethical aspects in engineering.
4. Learn about the MNCs and their practices.
5. Understand the ethical dimensions in engineering

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓	✓	✓	✓			
CO2						✓						
CO3						✓						
CO4								✓				
CO5						✓		✓				

18EIPC702	COMPUTER CONTROL OF PROCESSES	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the need for computers in process control.
- To study the fundamentals required for computer control of a process.
- To expose the students the stability analysis of discrete time system.
- To design and analyze digital controllers.
- To study some of the methods to identify the process.
- To know about programmable logic controller.

Unit–I : Introduction to Computer Control System

Need for computer in a control system-Building blocks of a computer control system, Representation and analysis of Sampled data control systems-Pulse Transfer function-Zero Order Hold and First Order Hold- Sampling Theorem-Sampling frequency Consideration- stability analysis: Jury's test and bilinear transformation. Modified Z transform of systems with dead time.

Unit–II : Digital Control Algorithms

Design for Set point and load changes: Deadbeat Algorithm - Dahlin's method - Kalman's approach - ringing phenomenon in digital controller- discrete PID controller algorithms - tuning techniques - selection of sampling time - dead-time compensation: Smith Predictor algorithm.

Unit–III : System Modeling and Identification

Mathematical model for processes: first order, second order processes with and without delay - higher order systems-process modeling from step test data - pulse testing for process identification - time-domain identification-linear least square algorithm.

Unit–IV : Programmable Logic Controllers (PLCs)

PLC Hardware components: discrete, analog and digital I/O modules: typical input and output field devices and their modules - I/O signal types and typical signal conditioning circuits - common electrical devices and symbols - intelligent I/O modules - Communication I/O modules- network communication module - distributed I/O - Central Processing Unit-

Unit–V : PLC Programming

Programming Languages: Ladder Diagram(LD) - Function Blocks Diagram (FBD) - Sequential Function Chart (SFC) - Instruction List (IL) - Structured Text (ST). programming devices: hand-held programmer - personal computer based programmer - Memory types used in PLCs - memory map - assigning I/O address and internal address - scan sequence.-Basic Programming: Relay-Type Instruction-Internal Relay instruction- timers-counters- program control instruction-data manipulation instruction-math instruction-sequencer and shift register instruction-development of programmes for typical applications -PLC Installation and maintenance.

TEXT BOOKS

1. P.B. Deshpande and R.H. Ash, Elements of Computer Process Control, Instrument Society of America, 1981.
2. Frank D.Petruzella, Programmable Logic Controllers, McGraw Hill Education India Private Limited, Fourth edition, 2016.

REFERENCES

1. C.D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2005.
2. Stuart Bennet, Real Time Computer Control, Second Edition,Pearson Education, 2005.
3. C.L. Smith, Digital Computer Process Control, Intext Educational Publishers, 1972.
4. Donald R.Coughnowr, Process Systems Analysis and Control, Mc-Graw Hill Education, Third Edition,2008.
5. W.Bolton, Programmable Logic Controllers, Elsevier Newnes,2006

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Analyze a system in discrete domain using Z-transform and modified Z-transform. (Unit I)
2. Design and develop algorithms for sampled data control system. (Unit II)
3. Understand various system identification and modeling techniques in time domain and in frequency domain.(Unit III)
4. Appreciate the application and hardware parts of a Programmable Logic Controller. (Unit–IV)
5. Develop and implement logical programs in PLC and trouble shoot, install and maintain a PLC system. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓										
CO2		✓	✓	✓							✓	
CO3		✓	✓	✓								
CO4				✓						✓		✓
CO5		✓	✓	✓	✓			✓				✓

18EICP706	INDUSTRIAL AUTOMATION LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To understand the need for computers in process control and fundamentals required for computer control of processes with MATLAB software.
- To study and implement an algorithm to identify the process parameters.
- To design and implement digital controllers using TUTSIM software.
- To study programmable logic controller with GE Fanuc make.
- To study data acquisition system using LABVIEW software.

LIST OF EXPERIMENTS

1. Open loop and closed loop response of the discrete time system.
2. Design of sampled data control system with Dead-beat controller using TUTSIM.
3. Design of Dead-time compensator using smith predictor algorithm and simulation using SIMULINK.
4. Process identification using Least Square Estimator algorithm using MATLAB.
5. Design and simulation of Kalman's Controller using TUTSIM.
6. Design and realization of digital filter.
7. Design of sampled data control system with Dhalin's controller and simulation using TUTSIM.
8. Study of LABVIEW software and Data acquisition using Lab View.
    a) Design of inverse response compensator and simulation using SIMULINK.
    b) Study of Bio signals.
9. Study of PLC (GE Fanuc make).

COURSE OUTCOMES

1. Able to design and implement a closed loop system in discrete domain.
2. Able to understand and develop ladder logics PLC.
3. Ability to use the software tools like MATLAB and TUTSIM.
4. Ability to use the software tool LABVIEW and data acquisition using LABVIEW.
5. Ability to identify process using LSE algorithm

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓								✓	
CO3				✓						✓		
CO4		✓										✓
CO5	✓		✓								✓	

18EIPV803	PROJECT WORK AND VIVA VOCE	L	PR	S	C
		-	10	2	6

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

METHOD OF EVALUATION

1. The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
2. The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
3. A project report is required at the end of the semester.
4. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

1. On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology
2. Carrying out any experimental works on chosen topics.
3. Understand the modelling, analysis, design and control aspects.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓		✓				
CO2	✓	✓	✓			✓		✓	✓	✓	✓	✓
CO3	✓	✓	✓			✓		✓	✓	✓	✓	✓

PE - PROFESSIONAL ELECTIVES

18EIPESCN	VIRTUAL INSTRUMENTATION & SMART SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic components of Virtual Instrumentation system.
- To learn to develop VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.
- To know about various VI Tool sets.
- To impart knowledge pertaining to Data Acquisition System.

Unit–I : Introduction

Review of Digital Instrumentation, Concept of Virtual Instrumentation- Historical perspective -need of VI advantages- definition of VI- Block diagram and architecture of a Virtual Instrument – Traditional Instruments versus Virtual Instruments - dataflow techniques, graphical programming in data flow, VI Debugging Techniques.

Unit–II : Data Acquisition and Communication Hardware

PC based data acquisition- Typical on board DAQ card- Organisation of the DAQ VI system-Data acquisition interface requirements – Embedded system buses-Selection of Data acquisition cards–Buffered data acquisition - VI Chassis requirements.

Data acquisition cards with serial and parallel communication system controllers. Ethernet - Networking basics for office & Industrial applications - VI customization-Instrument Drivers.

Unit–III : Programming Techniques

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formulae nodes, local and global variables, State machine, string and file I/O, Publishing measurement data in the web, Internet Connectivity.

Unit–IV : Analysis Tools and Application of VI

Analysis tools- Signal Processing Tool set- Fourier transforms, power spectrum, correlation methods, windowing and filtering. Math Toolsets, Hybrid Programming Concept, Control and Simulation Toolkit, On-Off controller, PID Control, Fuzzy algorithms.

Application of VI in process control designing of equipments like oscilloscope, Multimeter, Design of digital Voltmeters with transducer input- Applications of VI for Process Control and Instrumentation.

Unit–V : Smart Sensors

Definition – Sensor classification- General architecture of smart sensors-Description of smart sensor architecture- Block level design consideration for smart sensor-Importance and adoption of smart sensor-Types of smart sensors-compensation.

TEXT BOOKS

1. Gary Johnson, LabVIEW Graphical Programming, McGraw Hill, 2006.
2. Skolkoff, Basic concepts of LABVIEW 4, PHI, 1998.

REFERENCES

1. Paul Bates, Practical Digital and Communications, Prentice-Hall, 1987.
2. J.B.Dixit, AmitYadav, “Intelligent Instrumentation for Engineers”, University Science Press2012.
3. Lisa .K, Wells and Jeffrey Travis, LABVIEW for Everyone, Prentice Hall, 2009.
4. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
5. Jovitha Jerome, Virtual Instrumentation using LabVIEW, Eastern Economy edition, PHI learning private Ltd., 2010.
6. Gupta. S, Gupta. J.P, PC Interfacing for Data Acquisition and Process Control, ISA, 1994.

COURSE OUTCOMES

At the end of the course, students should be able to

1. Engineering Knowledge on VI. (Unit I)
2. Data acquisition using DAQ VI's. (Unit II)
3. Understand the Virtual Instruments basis concepts. (Unit III)
4. Incorporate various VI Toolsets based on the application. (Unit–IV)
5. Get the knowledge of Smart Sensors. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓						✓			
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓						✓	

18EIPESCN	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students understand basic theory and importance of instrumental analysis.
- To motivate the students learn the principles and the laws governing the operation of analytical instruments.
- To familiarize the students about the functioning of different types of analytical instruments.

Unit–I

Electromagnetic radiations - different regions - their wave lengths, frequencies and energies - interaction of EM radiations with matter - Principle of spectroscopy - emission, absorption, fluorescence spectroscopy - components of analytical instruments – radiation sources, variety and its types - monochromator - filters - detectors – photo emissive tube, PMT, photo diodes.

Unit–II

IR absorption spectroscopy – IR detectors – thermal detectors – golay pneumatic detector – sample handling techniques – Attenuated Total Reflectance – Lambert's, beer's law – single and double beam instruments – double beam spectrophotometer- non dispersive type.

Unit–III

NMR spectroscopy - Fourier Transform NMR spectroscopy – ESR spectroscopy – basic principles – instrumentation techniques and applications – principle of mass spectrometry – instrumentation techniques and applications – single focusing and double focusing mass analyzer – Quadra pole mass analyzer – TOF spectrometer.

Unit–IV

X-ray Spectroscopy – X-ray spectrometer - Production of X-rays - detection of X-rays and nuclear radiations- ionization chamber – principle of counters - proportional counter, GM counter, scintillation counter - solid state detector -

gamma ray spectrometer – isotope dilution and tracer techniques for quantitative estimation and analysis.

Unit–V

Electrochemical methods - electrical conductivity of liquids – sulphur-di-oxide monitor – principle of pH measurement – Technique to measure pH – Oxygen analyzers. Principles of gas and liquid chromatography - High Performance Liquid Chromotography – Super critical fluid chromatography.

TEXT BOOKS

1. Skoog, Holler &Nicman, Principles of Instrumental Analysis. Fifth Edition – SaundersCollege Publishers, HarcourtBraceCollege Publishing, 1998.
2. H.H.Willard, L.L.Merrit, J.A. Dean and F.A. Settle, Instrumental methods of Analysis. Seventh edition – CBS, Publishers & Distributors, 1995.

REFERENCES

1. D.A. Skoog and D.M.West, Principles of Instrumental Analysis, Second Edition, Holt–Saunders, 1980.
2. Douglas A.Skoog and James J. Leary, Principles of instrumental Analysis, Fourth Edition – Saunders College Publishing, 1992.
3. Khandpur.R.S, Handbook of Analytical Instruments, TMH,2003.
4. Bella,G.Liptak Process Measurements and Analysis, CRC press,LLP,2000.

COURSE OUTCOMES

1. Gain adequate knowledge about the analytical tools, principles and types of spectroscopy. (Unit I).
2. Importance and applications of IR spectroscopy (Unit II).
3. Importance and applications of Magnetic resonance spectroscopy and mass analyzer (Unit III).
4. Importance and applications of X-ray spectroscopy and dilution tracer analysis (Unit–IV).
5. Separation of similar materials using Chromatograph. (Unit V).

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓	✓								✓
CO2	✓		✓	✓								
CO3	✓		✓	✓								
CO4	✓		✓	✓								
CO5	✓		✓	✓							✓	

18EIPESCN	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the physical foundations of biological systems and the various electrodes used in medical field.
- To have a detailed understanding about the various electro physiological measurements in the human body.
- To gain knowledge on the measurement of non-electrical parameter in the human body.

- To understand the basic concepts of various medical imaging techniques and their applications.
- Understand medical assisting and therapy equipments.

Unit–I

Introduction, generalized medical instrumentation system, components of instrumentation system, physiological systems of the body, cardiovascular system. Respiratory system, Nervous system, CNS, PNS, generation of bioelectric potentials, Action potential, Resting potential, Neuronal communication.

Unit II

The electrode – electrolyte interface, Polarization, Ag/Agcl Electrodes, Body surface electrodes, Internal Electrodes. Transducers in general, Pressure Transducers, Temperature transducers, pulse sensors, Basic recording system, Direct Writing recorder, UV recorders, Thermal array recorders, Electrostatic recorder, Instrumentation Tape recorder

Unit–III

Information content of an image, Modulation transfer function, Noise – equivalent bandwidth, generation of X-rays, X-ray machine, computed Tomography, Magnetic Resonance Imaging – Principle, Image reconstruction techniques, Basic NMR components, Ultrasonic Imaging systems – Types of ultrasound imaging, Applications of different scan, Bio Telemetry.

Unit IV

Electrocardiogram, Effects of artifacts on ECG recordings, ECG recorder Principles, EEG & EMG recorders, ERG, Phonocardiogram, stethoscope, BP measuring Instrument - Sphygmomanometer and cardiac catheterization, ultrasonic blood flow meter, Principle of Photoelectric calorimeter, computerized patient monitoring system. Respiratory rate – Gas volume – Flow rate of CO_2, O_2 in exhaust air - PH of blood, ESR, GSR measurements – Plethysmography.

Unit–V

Pacemaker systems – Different pacing modes of operation, Transcutaneous Electrical Nerve stimulation (TENS) – Stimulation modes & application techniques, surgical diathermy, Heart lung machine, Hemo Dialysis, Lithotripsy, Laser applications in medicine, and introduction to electrical safety.

TEXT BOOKS

1. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, Biomedical Instrumentation and Measurements, Third Edition, PHI, 2011.
2. R.Anandanatarajan, Biomedical Instrumentation, PHI Learning, 2009.

REFERENCES

1. Prof.Venkataram.S.K, Bio-Medical Electronics & Instrumentation, Galgotia Publications, 2000.
2. R.S. Khandpar, Hand Book of Biomedical Instrumentation and measurement, McGraw Hill publishing Co., 1990.
3. Aston, Principles of Biomedical Instrumentation and measurements, McGraw Hill publishing Co., 1990.

4. M. Arumugam, Biomedical Instrumentation, Anuradha Agencies Publishers, VidayalKaruppar, 612 606, Kumbakonam, R.M.S: 1992.
5. John. Can. Brown, Introduction to Bio Medical Equipment Technology, Pearson Education of ASIA, 2001.

COURSE OUTCOMES

1. To educate students on the various physiological systems of the human body.(Unit-I)
2. To impart knowledge on the electrodes and allied recorders so as to obtain measurements from the human body. (Unit-II)
3. To provide insight into advanced imaging systems. (Unit-III)
4. To study the various bio signals along with the principles of measurement. (Unit-IV).
5. To provide an exposure to the medical equipments/instruments used in various departments and laboratories of a hospital. (Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓								✓		
CO2			✓									
CO3			✓	✓								
CO4			✓	✓							✓	
CO5			✓	✓					✓	✓		✓

18EIPESCN	POWER PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce students to the general layout of thermal power plant and also construction and principle of operation of the different sensing and indicating devices used at thermal power plants.
- The combustion chemistry of boiler and its efficiency calculation will be explained to students and to study about the various control techniques used in thermal power plant.
- To explain the function of steam turbine and its associated parameter measurement and to elaborate different types of safety methods involved in thermal power plant.
- To introduce students the functions of nuclear power plant and also construction and principle of operation of the different sensing devices and control systems employed at nuclear power plants.

Unit–I : Overview of Thermal Power Generation and its Instrumentation

General layout of a typical thermal power plant-Feed water and steam flow circuit-cooling water circuit- Fuel-ash circuit-Air-flue gas circuit. Piping and Instrumentation diagram of a thermal power plant, basic processes in boilers. Fuel measurement- Review of pressure and temperature measurement- steam and water flow measurement. Instrument applications in power stations-Review of indicating and recording instruments, water level gauges for boiler drums, closed circuit television instruments, gas analysis meters, smoke measurement, dust monitor-measurement of impurities in feed water and instruments-instrument maintenance aspects.

Unit–II : Boiler Combustion Process and its Efficiency Calculation

Boiler control objectives- combustion of fuels (gaseous, liquid and solid), excess air requirement, combustion chemistry and products of combustion, requirement for excess combustion air – calculation of efficiency of boilers: input/output method, heat loss method.

Various Control methods employed in water circuit

Controls in water circuit-Boiler drum level control-Superheated steam temperature control- superheaters-steam temperature control-water side steam temperature control-strategies of steam temperature control and de-superheaters-fire side steam temperature control-Steam pressure control.

Unit–III : Various Control Methods Employed in Air-Fuel Circuit

Control in air-fuel circuit-Combustion control and Furnace draft control. Flue gas analysis trimming of combustion control systems-combustion control for liquid and gaseous fuel boilers- coal or solid fuel stokers- combustion control for stoker fired boilers-pulverised coal burning systems- combustion control for pulverised coal fired boilers.

Unit–IV : Instrumentation & Control System Used for Turbine and Safety Aspects of Boiler

Turbine monitoring and control: speed, vibration, shell temperature monitoring-lubrication for Turbo-alternator- Turbo-Alternator cooling system. Intrinsic and Electrical safety- Interlocks for Boiler operation-Computer based control and data logging systems- Application of DCS in thermal power plant.

Unit–V : Nuclear Power Plant Instrumentation

Important components in instrumentation and control for nuclear power plant-Sensors and measurement systems for nuclear power plant-nuclear reactor control systems- Digital architectures in nuclear power plant-Radiation protection and monitoring.

TEXT BOOKS

1. K.Krishnasamy and M.PonniBala, Power Plant Instrumentation, PHI, second edition, 2013.
2. B.G.Liptak, Instrumentation in Process industries, Vol. I and II, Chilton Book Co.,1973.

REFERENCES

1. Sam.G.Dukelow, The control of boilers, Instrument society of America Press,1986.
2. Swapanbasu and Ajay debnath, Power Plant Instrumentation and Control Handbook: A Guide to Thermal Power Plants, Academic press, 2014.
3. Duncan Richardson, Plant Equipment & Maintenance Engineering Handbook, McGraw-Hill Education, 2014.

COURSE OUTCOMES

1. Ability to understand the function of boiler and also P&ID of thermal power plant.(Unit I)
2. Ability to understand the types of measuring equipment used in thermal power plant. (Unit–I and II)

3. Ability to identify and analyze the specific features of different types of control techniques used in Boilers.(Unit III)
4. Ability to understand the function of turbine and its lubrication method and understand the various safety methods involved in the proper functioning of thermal power plant. (Unit–IV)
5. Ability to understand the function of nuclear power plant, various sensors, control loops and safety measures employed in nuclear power plant. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓						✓	
CO2		✓									✓	
CO3			✓	✓	✓						✓	
CO4					✓						✓	
CO5											✓	

18EIPESCN	UNIT OPERATIONS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objectives of this course are to:

- Cover issues related to the definitions and principles of unit operations and unit systems.
- Discuss about the heat transfer and its applications elaborately.
- Explain the concepts of mass transfer and its applications in detail.
- Learn thoroughly the concepts of control systems with multiple loops and plant wide control strategy and its implementation to the unit systems.

Unit–I : Fundamentals of Unit Operations

Definitions and principles: Unit Operations - Unit Systems - Dimensional analysis-Basic concepts-Fluid Mechanics: Fluid statics and its applications: Hydrostatic Equilibrium-Application of fluid statics – Fluid flow phenomena: Laminar flow, Shear rate and Shear stress- Rheological properties of fluids – Turbulence – Boundary layers - Basic equations of fluid flow: Mass balance in flowing fluid; continuity – Differential momentum balance; Equations of motion.

Unit–II : Heat Transfer and its Applications

Heat transfer by conduction: Basic law of conduction - Steady state conduction – Unsteady state conductions- Principles of heat flow in fluids: Typical heat exchange equipment – Energy balances - Heat flux and heat transfer coefficients - Rate of heat transfer – Heat exchange Equipments: Types of heat exchangers, condensers and evaporators – Performance of tubular evaporators – Vapour recompression.

Unit–III : Mass Transfer and its Applications

Mass transfer theories – Mass transfer coefficients - Distillation: Flash distillation - Continuous distillation with reflux – Reflux ratio - Batch distillation – Definition of leaching and extractions: Leaching equipment – Liquid extraction equipment – Supercritical fluid extraction method – Drying of solids: Principles of drying – Drying equipments – Membrane separation process: Separation of gases – Separation of liquids.

Unit–IV : Control Systems with Multiple Loops

Cascade control: Cascade control for jacketed CSTR, Heat exchanger, Distillation column, Process furnace – Dynamic characteristics of cascade control – Selective control systems: Override control – Protection of boiler system, compressor system and steam distribution system –Auctioneering control and its examples – Split range control: Chemical reactor and Steam header.

Unit–V : Plant Wide Control

Plant wide control: Introduction – Block diagram descriptions only: Steady-state and dynamic effects of recycle- Unit operations: Supply side Vs Demand side – Compressor control – Heat exchangers – Adiabatic plug flow reactors – The control and optimization hierarchy – Petroleum refining example - Case Study: Reactor / Flash unit plant and Distillation columns.

TEXT BOOKS

1. Warren L. McCabe, Julian C. Smith, Peter Harriot, Unit operations of Chemical Engineering, 7th edition, McGraw Hill publication, 2014.
2. George Stephanopoulous, Chemical Process Control: Introduction to Theory and Practice, Pearson Education, 2015.

REFERENCES

1. B. Wayne Bequette, Process Control: Modelling, Design and Simulation, Prentice Hall of India, 2004.
2. Dale E. Seborg, Thomas.F.Edgar, Duncan A.Mellichamp, Process Dynamics and Control, 3rd Edition Wiley India Publication, 2010.
3. H.ScottFogler, Elements of Chemical Reaction Engineering, 3rd Edition, Prentice Hall of India, 2015.
4. I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publication, 2013.
5. Gade Pandu Rangaiah and Vinay Kariwala, Plantwide Control: Recent Developments and Applications, Wiley Publications, 2012.
6. William L. Luyben, Bjorn D.Tyreus, Michael L.Luyben, Plantwide Process control, McGraw Hill, 1999.
7. Christie John Geankoplis, Transport Processes and Separation Process Principles, Pearson Education, 4th Edition, 2003.

COURSE OUTCOMES

At the end of the course the student will be able to:

1. Understand the definitions and basic principles of unit operations and unit systems.(Unit I)
2. Acquire a thorough knowledge of fluid mechanics and its types of flow.(Unit II)
3. Gain sound knowledge on heat transfer and its applications.(Unit III)
4. Imbibe the concepts of mass transfer and master its applications.(Unit IV)
5. Analyze the significance of control systems with multiple loops and plant wide control strategy.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓				✓						✓	
CO3	✓				✓							
CO4	✓				✓							
CO5	✓	✓	✓								✓	

18EIPESCN	FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, Bernoulli's equation and apply the same to problems.
- To study the performance of Turbines, Radial flow, Reaction turbines and governing of turbines.
- To study the characteristics of Centrifugal pumps and reciprocating pumps.

Unit–I : Properties of Fluids, Fluid Pressure and its Measurement

Mass density, specific weight, specific volume, specific gravity, viscosity - Newton's law of viscosity - compressibility - surface tension and capillarity - real and ideal fluids.

Pressure - atmospheric and vacuum pressures - measurement of pressure by manometers and pressure gauges - total pressure and center of pressure – Buoyancy - metacentre - simple problems.

Unit–II : Dynamics of Fluid Flow

Kinematics of flow - types of fluid flow - continuity equation - Euler's equation of motion - Bernoulli's equation - practical applications - venturimeter, orificemeter and pitot tube. Simple treatment of orifices, mouthpieces, notches and weirs.

Flow through pipes - loss of energy due to friction - minor energy losses - hydraulic gradient and total energy line - flow through pipes in series - Flow through parallel pipes - power transmission through pipes - flow through nozzles.

Unit–III : Flow in Open Channels

Classification of flow in channels - Chezy's and Manning's formulae - most economical Rectangular, Trapezoidal and Circular sections of channel.

Non-uniform flow through open channels - specific energy and specific energy curve - critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.

Unit–IV : Impact of Jet and Turbines

Impact of jets - force exerted by a fluid on stationary and moving flat plates held in various positions - force exerted on curved plates - concept of velocity triangles.

Turbines: General layout of a hydroelectric power plant - Classification of turbines - velocity triangles for turbines - work done and efficiency, specific speed - Impulse turbine - Pelton Wheel – Reaction turbine - Francis turbine - simple problems - selection of turbines.

Unit–V : Pumps

Centrifugal pumps - main parts - work done - definitions of heads and efficiencies - multistage pumps - specific speed - priming - cavitation.

Reciprocating pumps - main parts - working principle – slip - indicator diagrams - effects of acceleration and friction on indicator diagrams - maximum speed of a reciprocating pump - study of air vessels.

TEXT BOOKS

1. Dr. P.N. Modi & Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi, 2015.
2. Dr. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Chennai, 2011.

REFERENCES

1. Dr. Jagdish Lal, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, **Ninth Edition,** New Delhi, 2014.
2. Dr. K.L. Kumar, "Engineering Fluid Mechanics" Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
3. Dr. V.P. Vasandani, "Theory and Design of Hydraulic Machines including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2. Use fluid dynamics for study of flow through pipes and flow in open channels.
3. Present hydraulic design for the construction of efficient hydraulic turbines and pumps.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓					✓		
CO2			✓		✓							
CO3			✓	✓	✓						✓	✓

18EIPESCN	PRINCIPLES OF COMMUNICATION SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- To introduce the principles of analog and digital communication systems involving different modulation and demodulation schemes.

Unit-I

Amplitude modulation: AM, generation of AM waves, demodulation, DSBSC, SSB, VSB, FDM, AM receivers, Optical Communication, Microwave communications and Satellite Communications

Unit-II

Angle modulation: Phase and Frequency modulation, Single-tone, narrow band, wide band and multi tone FM, generation and demodulation of FM, FM receivers.

Unit-III

Pulse Analog modulations: Sampling theorem, Time Division Multiplexing, PAM, Pulse time modulation.

Unit-IV

Pulse Digital modulation: PCM, Measure of Information, Channel capacity, DPCM, DM, Digital multiplexers.

Unit-V

Noise: SNR, Noise in AM and FM receivers, Noise in FM reception, FM Threshold effect, Preemphasis and de-emphasis, Noise in PCM system, Destination SNR in PCM system with quantization and channel noise, output SNR in DM system.

TEXT BOOKS

1. H.Taub & D.Schilling, Principles of Communication System, 3rd Edition, Tata McGraw Hill, 2007
2. J.S.Beasley&G.M.Miler, Modern Electronic Communication, 9th Edition, Prentice-Hall, 2008.

REFERENCES

1. B.P.Lathi, Modern Analog And Digital Communication systems, 3rd Edition, OxfordUniversity Press, 2007
2. B.Carlson, Communication Systems, 3rd Edition, McGraw Hill Book Co., 1986.
3. Sam Shanmugam, Digital and analog Communication Systems, John Wiley, 1985.

COURSE OUTCOMES

Student can able to

1. Develop an understanding of need for modulation and generation & detection of Analog modulation techniques (Unit-I).
2. Explore AM and FM Super heterodyne receiver working principle (Unit-II).

3. Discuss the techniques for generation and detection of pulse Analog modulation Techniques (Unit-III)
4. To understand the basic operation involved in PCM like sampling, quantization & encoding and are able to calculate and derive entropy and channel capacity (Unit-IV).
5. To compare different communication system with various modulation techniques in the presence of noise by analytically (Unit-V).

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓				✓	✓		
CO2	✓			✓								
CO3			✓	✓					✓			✓
CO4		✓		✓					✓			
CO5	✓				✓	✓			✓		✓	✓

18EIPESCN	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To review digital design fundamentals and to emphasize VHDL in Digital design.
- To give an overview of PLD, CPLD & FPGA and basic principles in the construction of these programmable devices.
- To present several design examples with synthesizable VHDL code describing them at different levels.
- To present issues related to implementation of a digital system in FPGA.
- To introduce advanced features of VHDL, hardware testing of combinational and sequential logic and design for testability.

Unit–I : Logic Design Fundamentals

Review of logic design fundamentals - combinational logic - flip-flops and latches - Mealy sequential circuit design - Moore sequential circuit design - sequential circuit timing - tri-state logic and busses.

Unit–II : VHDL

Introduction to VHDL - VHDL description of combinational circuits - sequential statements and VHDL processes - modeling flip-flops using VHDL processes - processes using wait statements - VHDL delays - compilation, simulation and synthesis of VHDL code - VHDL data types and operators - VHDL libraries - behavioral and structural VHDL - variables, constants and signals - arrays and loops in VHDL - assert and repeat statements.

Unit–III : PLD

Introduction to Programmable Logic Devices (PLDs): overview of PLDs - simple PLDs - complex PLDs - FPGAs. Design Examples: BCD to seven segment display decoders - BCD adder - traffic light controller - state graphs for control circuits - scoreboard and controller - synchronization and de bouncing - ADD and shift multipliers.

Unit–IV : FPGA

State Machine (SM) charts - derivation of SM charts - binary multiplier design - realization of SM charts - implementation of binary multiplier controller. Designing with FPGAs: Implementing functions in FPGAs - Shanon's decomposition - carry chains - cascade chains - logic blocks in commercial FPGAs - dedicated memory in FPGAs - dedicated multipliers in FPGAs - FPGA capacity - design translation, mapping, placement and routing.

Unit–V : Design and Testing

VHDL functions - VHDL procedures - attributes - multi valued logic and signal resolution - IEEE 9-valued logic system - Generics. Hardware testing and design for testability: testing combinational logic - testing sequential logic - scan testing - boundary scan - built-in self test.

TEXT BOOKS

1. Charles H. Roth, Lizy Kurian John, Digital System Design using VHDL, Second Edition, Thomson Learning Inc., 2008.
2. Ian Grout, Digital Systems Design with FPGAs and CPLDs, Newnes imprint of Elsevier Ltd., 2010.

REFERENCE BOOKS

1. K.C. Chang, Digital Systems Design with VHDL and Synthesis - An Integrated Approach IEEE Computer Society, 1999.
2. J. Bhasker, A VHDL Primer, Third Edition, Prentice Hall of India, 1999.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Design of various digital communication systems (Unit I).
2. Develop VHDL code describing them at various levels (Unit II).
3. Implement the designed digital system using programmable devices (Unit III).
4. Utilize advanced features of VHDL with FPGA in their system design (Unit IV)
5. Develop digital system with testability (Unit V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓	✓							✓	
CO2		✓	✓									
CO3		✓	✓	✓			✓				✓	
CO4				✓			✓		✓	✓		✓
CO5				✓			✓		✓	✓		✓

18EIPESCN	**REAL TIME OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students to the fundamentals of interaction of OS with a computer and user computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features.
- To compare types and Functionalities in commercial OS.
- To discuss the application development using RTOS.

Unit–I : Review of Operating Systems

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed scheduling-Fault &recovery.

Unit–II : Overview of RTOS

RTOS Task and Task state –Multithreaded Premptive scheduler- Process Synchronisation- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks.

Unit–III : Real Time Models and Languages

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

Unit–IV : Real Time Kernel

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

Unit–V : RTOs Application Domains

Case studies-RTOs for Image Processing – Embedded RTOs for Network communication – RTOs for fault-Tolerant Applications – RTOs for Control Systems.

TEXT BOOKS

1. Silberschatz,Galvin,Gagne, Operating System Concepts,6th ed,John Wiley,2003.
2. Raj Kamal, Embedded Systems- Architecture, Programming and Design, Tata McGraw Hill, 2006.

REFERENCES

1. Herma K., Real Time Systems – Design for distributed Embedded Applications, Kluwer Academic, 1997.
2. Charles Crowley, Operating Systems-A Design Oriented approach, McGraw Hill 1997.
3. C.M. Krishna, Kang, G.Shin, Real Time Systems, McGraw Hill, 1997.
4. Raymond J.A.Bhur, Donald L.Bailey, An Introduction to Real Time Systems, PHI 1999.
5. MukeshSighal and N G Shi,Advanced Concepts in Operating System, McGraw Hill 2000.
6. D.M.Dhamdhere, Operating Systems,A Concept-Based Approch,TMH,2008.

COURSE OUTCOMES

1. Will get to know the fundamentals of interaction of OS with a computer and User computation. (Unit–I : & II)
2. Will get to know the programming logic of modeling Process based on range of OS features. (Unit–III : & IV)
3. To help the students to come with design and development of solutions using RTOS. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓	✓		✓		✓		
CO2	✓		✓		✓	✓		✓	✓		✓	
CO3	✓		✓		✓	✓		✓	✓		✓	✓

18EIPESCN	COMPUTER NETWORKS AND DCS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To provide fundamental knowledge about computer networks.
- To provide comprehensive knowledge about the methods of internetworking.
- To give basic knowledge in the architecture and local control unit of distributed control system.
- To give adequate information in the interfaces used in DCS.
- To give basic knowledge about HART (Highway Addressable Remote Transducer) and field bus technology.

Unit–I :Data Acquisition Systems (DAS)

Review of A/D Converters - different Configurations of DAS - Multiplexing - Data Communication - transmission lines and digital signals - Practical line interface circuits – RS232, RS 485 – GPIB - USB.

Unit–II : Introduction to network

MODEM - Data coding methods - Error detection, correction and encryption -. Introduction to Networks - Network topology and media - Transmission Characteristics of network - Open System interconnection model of ISO - Data link Control protocol: HDLC.

Unit–III : Network protocols

Media access protocol: Command/response - Token passing - CSMA/CD, TCP/IPBridges - Routers - Gateways - Standard ETHERNET configuration – Industrial ETHERNET- Special requirement for networks used for Control - Networking of PLC- Introduction to SCADA.

Unit–IV : DCS

Methods of Computer Control of Processes, their configuration and comparison: direct digital control, supervisory digital control and Distributed Control System (DCS). DCS - Local Control Unit (LCU) and architecture - LCU languages - Process interfacing issues. Operator interface - Requirements - displays - alarms and alarm management. Engineering interface - requirements.Factors to be considered in selecting a DCS.

Unit–V : HART and Field bus

HART: Introduction - Evolution of Signal standard - HART Communication protocol - Communication modes – HART networks - Control System interface - HART Commands – HART field Controller implementation - HART and the OSI model.

Field Bus: General Field bus architecture - basic requirements of field bus standard - Field bus topology - Interoperability – Interchangeability - CAN bus.

TEXT BOOKS

1. Behrouz A. Forouzan, Data communications and Networking, Tata Mcgraw Hill, 2004.
2. Michale P. Lucas, Distributed Control Systems,VanNostrand Reinhold Co., 1986.

REFERENCE BOOKS

1. William L. Schweber, Data Communications, McGraw-Hill, 1988.
2. A.S. Tanenbaum, Computer Networks, Second Edition, Prentice-Hall of India, 2004.
3. Romilly Bowden, HART Application Guide, HART Communication Foundation, 1999.
4. Paul Bates, Practical Digital and Communications, Prentice-Hall, 1987.
5. LawerenceM.Thompson, Industrial data Communications, ISA Press, 1997.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basic principle of communication and the modes of data transmission. (Unit I)
2. Understand the various types of bus devices used for data communication in industry.(Unit II)
3. Implement the automation concepts in a process industry. (Unit II)
4. Understand about profibus for data communication. (Unit III)
5. Use HART and FiledBus protocols for process industries. (Unit–IV and V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2		✓				✓						
CO3				✓	✓						✓	
CO4			✓	✓								
CO5				✓				✓		✓		✓

18EIPESCN	VLSI SYSTEM DESIGN	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To provide a survey of VLSI design, emphasize on Intellectual property (IP) based design, introduce basic concepts and tools for layout design.
- To learn the basic model, optimization, implementation, verification and testing methods for sequential machine design.
- To acquire the knowledge of floor plan design methodologies, chip-level layout and circuit design with area, delay and power optimization.
- To learn about register transfer design, architecture design for low power systems and IP components in architecture design.

Unit–I : Digital Systems and VLSI Design

Applications and advantages of VLSI systems- A survey of VLSI manufacturing and Design- CMOS technology-Integrated circuit design techniques-Intellectual property (IP) based design.

Unit–II : Layout Design and Logic Gates

Fabrication processes-Transistors- Wires and vias- Fabrication theory and practice- Layout design and tools. Combinational logic functions-static complementary gates-switch logic-Alternative Gate circuits-Low power gates- Delay through resistive interconnect- Delay through Inductive Interconnect- Gates as IP.

Unit–III :Combinational Logic Networks and Sequential Machines

Standard cell-based Layout - Combinational network delay - Logic and interconnect design - power optimization - switch logic networks. Latches and Flip-flops-sequential systems and clocking disciplines- Performance analysis - clock generation - Sequential system design- power optimization - design validation and sequential testing.

Unit–IV :Subsystem Design and Floor Planning

Introduction - Combinational Shifters - Adders - ALUs - Multipliers - High density memory - Image sensors - FPGAs - PLAs - Buses and networks On-chips - Data paths - Subsystems as IP. Introduction - Floor planning methods - Global interconnects - Floor Plan design - Off-chip connections.

Unit–V :Architecture Design

Register Transfer Design- Pipelining - High level synthesis- Architectures for low power design - GAL systems - Architecture testing - IP components - Design methodologies- Multiprocessor system-on-chip design.

TEXT BOOKS

1. Wayne Wolf, Modern VLSI Design, Fourth Edition, Prentice Hall India, 2010.
2. Douglas A.Pucknell and Kamran Eshraghian, Basic VLSI Design, Third Edition, Prentice Hall of India, 2011.

REFERENCES

1. Neil H. E. Weste and David Harris, Principles of CMOS VLSI Design, Fourth Edition, Addison Wesley, 2010.
2. Caver Mead and Lynn Conway, Introduction to VLSI Systems, BS Publications, 2008.
3. M. John and S. Smith, Application-Specific Integrated Circuits, Addison-Wesley, 1997.
4. Neil H. E. Weste, Kamran Eshraghian, and Micheal John Sebastian Smith, Principles of CMOS VLSI Design - A Systems Perspective, Addison Wesley, 2001.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Perform IP based design. (Unit I)
2. Handle technology dependent parameters in the fabrication process effectively. (Unit II)
3. Perform delay analysis and testability properties of combinational logic networks including both interconnect and gates.(Unit–III & Unit–IV)
4. Design an architecture that executes the desired function and that meets area, performance and testability constraints.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓									✓
CO3		✓	✓	✓								
CO4			✓	✓					✓		✓	✓

18EIPESCN	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study architecture of ARM processor.
- To introduce the concept assembly programming for ARM using THUMB instruction set.
- To understand the concept of interfacing of memory and peripherals to ARM PROCESSOR.
- To design operating system for ARM.

Unit–I : ARM Architecture

ARM architecture - RISC processor - ARM programming model - ARM development tools – Arm organization and implementation - 3 stage and 5 stage pipeline ARM organization – ARM instruction execution - ARM implementation – ARM co processor interface.

Unit–II : ARM Assembly Programming

ARM assembly programming - data processing and transfer instructions – control flow instructions – conditional execution –branch instructions - Co processor instructions – data operations – register transfer –break point instruction – memory faults –Arm architecture variants - writing simple assembly language programs .

Unit–III : THUMB Instruction Set

The THUMB Instruction set - Thumb programmer's model – Thumb branch instruction – Thumb software interrupt and data processing instructions – Thumb single and multiple register data transfer instructions – Thumb implementation – Thumb applications.

Unit IV System Development

Architectural support for system development – ARM memory interface – advanced microcontroller bus architecture - ARM reference peripheral specification – hardware system prototyping tools – ARMualtor – JTAG boundary scan test architecture – embedded trace – signal point support –ARM processor cores – ARM7TDMI – ARM 8.

Unit V Operating System

Architectural support for operating system – ARM system control coprocessor – CP15 protection unit registers – ARM protection unit – CP15 MMU registers – ARM MMU architecture - synchronization – context switching – Embedded ARM applications – VLSI ruby II advanced communication processor – VLSI ISDN subscriber processor.

TEXT BOOKS

1. Furber,S., ARM System on Chip Architecture Addison Wesley trade Computer Publication, 2000.

REFERENCES

1. David seal,ARM architecture reference model, Addison Wesley, 2003.
2. Andrew sloss,Dominicsymes and chris wright, ARM system developers guide Morgan Kaufmann.

COURSE OUTCOMES

1. Understand the basis of RSIC processor. (Unit I)
2. Programming the ARM processors.(Unit II)
3. Design of operating system for advanced microcontrollers.(Unit III)
4. By the end of this course, the students will be able to know about the functions and operations of the ARM processor (Unit IV)
5. Develop assembly code for various applications.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓										✓	
CO3	✓		✓								✓	
CO4	✓			✓							✓	✓
CO5	✓			✓							✓	✓

18EIPESCN	EMBEDDED SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study the basis of embedded system components
- To learn concept of embedded networking and various buses
- To study embedded programming using embedded C
- To study basis RTOs
- To design embedded system for real time applications

Unit–I :Introduction to Embedded Systems

Definition and Classification – Overview of Processors and hardware units in an emedded system – Embedded Systems on a Chip (SoC) –memory organization-structural units in a processor-processor selection for an embedded system-memory selection -interfacing processor ,memories and I/O devices-Development and debugging-Embedded network-Distributed embedded architectures – networks for embedded systems – I^2C bus – CAN bus.

Unit–II :PIC Microcontroller

Overview of PIC 18 family- PIC 18 architecture – Pin configuration – RSIC architecture - Instruction set – Addressing modes - I/O port programming – Timer – serial port – Interrupt programming.

Unit–III :Embedded Programming

Embedded programming – modular and C code construction – creating and accessing data in C – C programming structures – programming elements – queues

– stacks - list and order lists - C Cross compilers – introduction RAID and KEIL – writing simple programs in embedded C.

Unit–IV : Real Time Operating System

Real Time operating system- operating system services – network operating system - multiple tasks and multiple processes – processes – context switching – scheduling polices – Interprocess communication mechanisms – evaluating operating system performance – power optimization strategies for process –use of Micro C/OS-II and Vx Works.

Unit–V :System Design Techniques

System design techniques – design methodologies – requirement analysis – specifications – quality assurance – design example – telephone PBX – Ink jet printer – set top boxes – smart card.

TEXT BOOKS

1. Rajkamal, Embedded Systems Architecture, Programming and Design, Tata McGraw Hill,2004.
2. Muhammad ali mazidi, Rolin Mckinlay and Danny Causey,PIC Microcontroller and Embedded system, Pearson eduction, 2008.

REFERENCES

1. Steve Heath, Embedded Systems Design, Newnes.
2. David E. Simon, An Embedded Software Primer, Pearson Education.
3. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Harcourt India, Morgan Kaufman Publishers
4. Todd D.Morton,' Embedded microcontroller' pearson education - 2003
5. Frank Vahid and Tony Givargis,Embedded Systems Design- A Unified Hardware/ Software Introduction, John Wiley & Sons.

COURSE OUTCOMES

1. Understand the basis of embedded system and embedded networking.(Unit I)
2. Learn the architecture and programming of PIC18.(Unit II)
3. Design of embedded networking.(Unit III)
4. Design of embedded system using Embedded C and RTOS.(Unit–IV)
5. By the end of this course, the students will be able to formulate design and analyze any embedded system for real time applications. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2	✓											
CO3	✓		✓								✓	
CO4	✓		✓	✓							✓	
CO5	✓			✓				✓				✓

18EIPESCN	POWER ELECTRONICS DRIVES AND CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To learn about semi-conductor power devices.
- To acquire knowledge about the power converters for various loads.
- To implement the power converters for the drives by efficient control algorithms.
- To understand the need for the series & parallel connections and protection circuits.
- To study about the generation of control pulses for power electronic converters and their applications.

Unit–I :Semiconductor Power Devices

SCR characteristics - Two transistor analogy - Methods of turning on and turning off - Other members of SCR family - Series and parallel connection of SCRs - Thyristor protection. Other semiconductor devices: Power transistors, Power MOSFETs, GTOs, IGBT. Generation of control pulses for power electronic converters.

Unit–II :Phase Controlled Rectifiers

Single phase controlled rectifiers - Half wave controlled rectifier with i) R load ii) R,L load iii) R,L load and free wheel diode iv) R,L load and battery - Full wave controlled rectifier- half controlled bridge rectifier and fully controlled bridge rectifier with the above four types of loads. Three phase controlled rectifiers: Half controlled bridge - Fully controlled bridge.

Unit–III :Single Phase Inverter

Series , Parallel & Bridge inverters - Current source inverter.

DC choppers

Various types - Step-up, step down & step up/down chopper, chopper configuration – AC Chopper. AC voltage controller.Single phase Cycloconverter.

Unit–IV :DC Motor Control

Schemes for DC motor speed control, Single phase and three phase SCR drives - reversible SCR drives - chopper controlled DC drives. Closed loop control of DC drives.

Unit–V :AC Motor Control

Speed control methods for induction motor - controlled slip system - slip power recovery scheme - braking of induction motor. Synchronous motor control.

TEXT BOOKS

1. M.D. Singh, K.B. Khanchandani, Power Electronics, Tata McGraw Hill, 2003.
2. Vedam Subrahmanyam, “Electric Drives-Concept & Applications”, Second edition, TataMcGraw Hill, 2011.

REFERENCES

1. M.H. Rashid, Power Electronics, Prentice-Hall, 1988.
2. C.N.Pauddar, Semi conductor Power Electronics (Devices and circuits), Jain Brothers, New Delhi, 1999.
3. S.N. Singh, Text Book of Power Electronics, DhanpathRai & Co., New Delhi, 2000.

4. P.S. Bhimbhra, Power Electronics, Khanna Publishers, Third Edition, New Delhi, 2005.
5. M. Ramamoorthy, An Introduction to Thyristors and their Applications, East West Press,1991.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the characteristics & applications of power semi-conductor devices. (Unit I)
2. Understand the AC to DC, DC to AC, and DC to DC converters. (Unit II)
3. To design a firing circuit that solves the specific control problem. (Unit III)
4. Understand the issues related implementation of drives & control. (Unit–IV and V)
5. Understand the recent trends in power converter technology. (Unit–I to V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓										
CO2		✓										
CO3		✓	✓								✓	
CO4				✓	✓					✓		✓
CO5				✓		✓		✓		✓		

18EIPESCN	SOFT COMPUTING TECHNIQUES FOR PROCESS CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students to the concepts of Neural Networks, Fuzzy Logic andGenetic Algorithm.
- To provide adequate knowledge of application of neural network and Fuzzy logic controllers to real time systems.
- To expose the ideas of GA in optimization and control.

Unit–I

Motivation for the development of neural networks - Biological neural networks- Artificial neural networks - Application areas- Common activation functions-Biases and thresholds- Linear seperability- Data representation- Types of learning-Basic Learning laws: Hebb's rule - Delta rule -Widrow and Hoff LMS learning rule.

Unit–II

Architecture, Algorithm, Applications: McCulloch-Pitts Neuron-Hebb Net-Perceptron-Hopfield Neural net -Standard Back Propagation Neural Net.

Unit–III

Neural Networks based on Competition: Fixed-weight competitive nets - Kohonen self-organizing Maps - Adaptive Resonance Theory. Neural Network for Control: Neuro controller - Functional block diagram - Inverse dynamics – System identification. Case studies: Neuro controller for DC motor speed control - Neuro controller for a Temperature Process.

Unit–IV

Introduction to Fuzzy Logic: Fuzzy sets- Properties of Fuzzy sets- Operations on Fuzzy sets-Fuzzy relations: Operations- Properties. Fuzzy Cardinality- Fuzzy tolerance and Equivalence relations- λ- cuts for fuzzy relations-Fuzzification -

Membership functions- Membership value assignments- Linguistic variables - Linguistic approximation-Fuzzy statements: Assignment statements - conditional statements- unconditional statements. Fuzzy rule base: Canonical rule formation-decomposition of compound rules. Defuzzification methods.

Unit–V

Fuzzy logic Control system- Fuzzy logic Controller for a temperature process-Introduction to neuro-fuzzy and fuzzy-neuro control systems-Introduction to GA.

TEXT BOOKS

1. LaureneFausett, Fundamentals of Neural Networks, Pearson Education Pvt.Ltd, India, 2013.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, John Wiley & Sons Ltd., India, 2014.

REFERENCES

1. Yegna Narayanan, Artificial Neural Networks, Eight Edition, PHI Learning Pvt. Ltd. New Delhi, 2003.
2. Simon Haykin Neural Networks, Fifth Edition, Pearson Education. Pvt. Ltd, 2005.
3. Sudarshan K. Valluru and T. NageswaraRao, Introduction to Neural Networks,Fuzzy Logic and Genetic algorithms, Jaico Publishing Home, 2010.
4. David.E.Goldberg, Genetic Algorithm in Search, Optimization and Machine learning, Fourth Edition, Pearson Education Pvt. Ltd., India, 2009.
5. ChanderMohan, An introduction to Fuzzy set theory and Fuzzy Logic, MV Learning, 2015.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basics of neural networks.(Unit I)
2. Derive the different algorithms. (Unit II)
3. Understand the concept of neuro controller. (Unit III)
4. Understand the basics of fuzzy logic controller (Unit–IV)
5. Understand the concept of fuzzy control. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓		✓							✓	
CO3		✓		✓	✓			✓	✓			
CO4	✓	✓		✓				✓				
CO5		✓		✓	✓			✓	✓			

18EIPESCN	NON LINEAR CONTROL SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To give exposure to nonlinear control and to discuss about the stability and applications of non linear systems.
- To acquire knowledge in the basics of nonlinear control.
- To understand the describing function analysis and stability analysis.
- To understand the need for sliding mode control.

Unit–I : Non Linear Systems

Non-linear Systems - Behavior of non-linear systems, jump resonance, subharmonic oscillation- Phase plane analysis: Singular points - construction of phase portraits using isoclines and delta method - limit cycles-existence of limit cycles.

Unit–II : Describing Function Analysis

Describing Function Analysis: Describing Function Fundamentals- Applications of Describing Functions-Basic Assumptions and definitions-Computing Describing Functions. Common nonlinearities in control systems- Describing Functions for common nonlinearities.Describing Function Analysis of Non-linear Systems-examples.

Unit–III : Stability Analysis

Stability analysis: Stability in the sense of Lyapunov's - second method of Lyapunov's - Lyapunov's stability analysis of linear time invariant systems and nonlinear system- Krasovskii's theorem- variable gradient method of generating Lyapunov's functions.

Unit–IV : Modelling and Control of Non-Linear Systems

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification –Real-time parameter estimation for nonlinear systems – Nonlinear PID controller - Gain scheduling control – case studies.

Feedback Linearization-Input-state and Input-output linearization using Lie derivative and lie brackets.

Unit–V : Sliding Control

Sliding Control: Sliding Surfaces- sliding condition-Filippov's construction of the equivalent dynamics –examples.Direct implementation of Switching control laws-Switching control in place of PWM and Dither signals. Continuous Approximations of switching control laws.

TEXT BOOKS

1. I.J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New AgeInternational (P) Ltd., Publishers, 2005.
2. Gibson, J.E, Nonlinear Automatic Control, McGraw Hill Book Co, 1963.

REFERENCES

1. Hassan K Khalil, Nonlinear Systems, Prentice Hall, 2002, Third Edition, 2002.
2. HenkNimeijer, Nonlinear Dynamical Control Systems, Springer Verlag,NewYork, 1990.
3. Alberto Isidori, Nonlinear Control Systems (3rd edition), Springer Verlag, 1995.
4. Jean-Jacques Slotine and Weiping Li, Applied Nonlinear Control, Prentice Hall, New jersey, 1991.
5. K.M.Hangos,J.Bokor and G.Szederkrnyi, Analysis and control of Nonlinear Process systems, Springer

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basics of nonlinear systems.(Unit I)

2. Derive the describing function. (Unit II)
3. Understand the stability analysis of nonlinear systems. (Unit III)
4. Implement modelling of nonlinear systems and feedback linearization design. (Unit–IV)
5. Understand the recent trends in sliding mode control. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2		✓									✓	
CO3		✓		✓				✓	✓			
CO4		✓		✓				✓	✓			✓
CO5	✓				✓			✓	✓	✓		

18EIPESCN	OPTIMAL CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study about the statement of optimal control problem, formulation of optimal control problem and selection of performance measure.
- To introduce students to the fundamental concepts of calculus of variation.
- To understand the concepts of variational approach to optimal control problems.
- To derive the expression for continuous and discrete linear optimal regulator problem.
- To study about the concepts of dynamic programming and its application.

Unit–I : Optimal Control Problems and Performance Measures

Statement of optimal control problem - problem formulation and forms of optimal control - selection of performance measures.

Unit–II : Calculus of Variation

Fundamental concepts – extremum functionals involving single and several independent functions - piecewise smooth extremals - constrained extrema.

Unit–III : Variational Approach to Optimal Problems

Necessary conditions for optimal control - Pontriyagin's minimum principle - state inequality constraints - minimum time problem - minimum control effort problems.

Unit–IV : LQ Control Problem

Linear optimal regulator problem - Matrix Riccati equation and solution method - choice of weighting matrices - steady state properties of optimal regulators - linear tracking problem.

Unit–V : Dynamic Programming

Principle of optimality - recurrence relation of dynamic programming for optimal control problem - computational procedure for solving optimal control problems - characteristics of dynamic programming solution - dynamic programming application to discrete and continuous systems - Hamilton Jacobi Bellman equation.

TEXT BOOKS

1. D.E.Kirk, Optimal Control Theory-An Introduction, Dover Publications, New York, 2012.
2. Michael Athans and Peter L. Falb, Optimal Control: An Introduction to the Theory and Its Applications, Dover Publications, New York, 2007.

REFERENCES

1. Katruhiko Ogata, Modern Control Engineering, Prentice Hall of India Ltd, Fifth Edition, 2010.
2. M.Gopal, Modern Control Systems Theory, Third Edition, New Age International Publishers, 2015.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Ability to understand the optimal control problem formulation and its selection of performance measures.(Unit I)
2. Ability to recognize and recall the fundamentals of calculus of variation. (Unit II)
3. Ability to implement optimal control concept for minimum time and minimum control effort problems. (Unit III)
4. Ability to apply Matrix Ricatti Equation for real world problem. (Unit–IV)
5. Ability to understand the concepts of dynamic programming. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓									
CO3	✓	✓	✓									
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓						✓	✓

18EIPESCN	MODEL PREDICTIVE CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the fundamentals of model predictive control.
- To study the methods of predictive control.
- To analyse the implementation issues of MPC.
- To design and implement MPC algorithm for the given process.

Unit–I : Model Predictive Control

Introduction to Model Predictive Control strategy – Model predictive control elements – Prediction model, process model – Objective function – Control law – State space formulation.

Unit–II : Model Predictive Control Schemes

Dynamic matrix control – Model algorithmic control - Predictive functional control -Formulation of generalized model predictive control – Closed loops relationships.

Unit–III : Constrained model predictive control scheme

Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

Unit–IV : Methods for implementing Model Predictive Control

Model predictive control and multi-parametric programming - Implementation of model predictive control for uncertain systems - Implementing Nonlinear Model Predictive Control Scheme-Closed loop min-max model predictive control implementation and dead time consideration.

Unit–V :Case studies

Self tuning GPC strategy and gain scheduling GPC for solar power plant – Design of MPC for a petrochemical industries.

TEXT BOOKS

1. E.F.Camacho and C.Bordons, Model Predictive Control, Springer, Second corrected Edition 2007.
2. B.W. Bequette, Process Control: Modeling, Design and Simulation, Prentice Hall, 2003.

REFERENCES

1. Seborg Edgar, Mellichamp.Doyle, Process Dynamics and Control John Wiley & Sons Pvt. Ltd., Third Edition 2013.
2. Carlos E.Garcia et.al, Model Predictive Control: Theory and Practice A Survey, Automatica, vol. 25, issue 3, pp. 335-348, May 1989.

COURSE OUTCOMES

After completion of this paper the student will understand

1. The basics of MPC including tuning parameters such as prediction horizon, control horizon and control weight. (Unit I)
2. The basics of Dynamic matrix control and model algorithmic control.(Unit II)
3. Effect of tuning parameters on control performance, stability and ability to handle constraints. (Unit III)
4. Development of various methods of MPC algorithm. (Unit–IV)
5. Implementation issues and applications of MPC in industry.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓		✓								
CO2	✓	✓		✓							✓	
CO3	✓	✓		✓								
CO4	✓		✓	✓							✓	✓
CO5			✓	✓	✓	✓		✓				✓

18EIPESCN	**FAULT DETECTION AND DIAGNOSIS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To understand different faults that occurs in sensors and actuators.
- To identify kind, size and magnitude of the fault by model based and model free methods.
- To understand the structured residuals and directional structured residuals.
- To understand the methods to estimates the faults.

Unit–I : Introduction to Fault Detection and Diagnosis (FDD)

Scope of FDD: Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances - Different issues involved in FDD Typical applications.

Unit–II : Analytical Redundancy Concepts

Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

Unit–III : Design of Structured Residuals

Introduction- Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation.

Unit–IV : Design of Directional Structured Residuals

Introduction – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation- Introduction of Residual generation of parametric fault – Robustness Issues- Statistical Testing of Residual generators

Unit–V : Data Driven Methods

Principal Component Analysis – Partial Least Squares - Canonical Variate Analysis – Knowledge Based Methods.

TEXT BOOKS

1. Janos J. Gertler, Fault Detection and Diagnosis in Engineering systems, Second Edition, Marcel Dekker, 1998.
2. R. Isermann, Fault-Diagnosis Systems An Introduction from Fault Detection to Fault Tolerance, Springer Verlag, 2006.

REFERENCES

1. L.H. Chiang, E.L. Russell and R.D. Braatz, Fault Detection and Diagnosis in Industrial Systems – Springer-Verlag-London, 2001.
2. Rami S. Mangoubi, Robust Estimation and Failure detection, Springer-Verlag, London 1998.

COURSE OUTCOMES

1. Ability to understand different approaches to Fault Detection and Diagnosis. (Unit I)
2. Ability to estimate the kind, size, type and time of occurrence of faults by analytical methods.(Unit II)
3. Ability to design and detect single and multiple faults using structured residual approach. (Unit III)
4. Ability to design and detect single and multiple faults using directional structured residual approach. (Unit–IV)
5. Ability to Understand the data driven methods like principle, partial least square methods etc., (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓	✓	✓								✓
CO3			✓	✓							✓	
CO4			✓	✓							✓	
CO5				✓							✓	✓

OE - OPEN ELECTIVES

18EIOESCN	TRANSDUCER ENGINEERING	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers
- To introduce advances in sensor technology

Unit I

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

Unit II

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement.

Unit III

Self and mutual inductive transducers- capacitive transducers, eddy current transducers, proximity sensors, tacho generators and stroboscope.

Unit IV

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers, Basics of Gyroscope.

Unit V

Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

TEXT BOOKS

1. John P. Bentley, Principles of Measurement Systems, Pearson Education, 4th Edition, 2005.
2. Doebelin E.0, Measurement Systems - Application and Design, McGraw-Hill, 4th Edition, 2004.

REFERENCES

1. Murthy D. V. S, Transducers and Instrumentation, Prentice Hall, 2nd Edition, 2011.
2. James W.Dally, Instrumentation for Engineering Measurements, Wiley, 2nd Edition, 1993.

3. John G.Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition, 2008.
4. S.M. Sze, Semiconductor sensors, John Wiley & Sons Inc., 1994.

COURSE OUTCOMES

At the end of this course, students be able to

1. Familiar with the basics of measurement system and its input, output configuration of measurement system (Unit-I).
2. Familiar with both static and dynamic characteristics of measurement system (Unit-II)..
3. Familiar with the principle and working of various sensors and transducers. (Unit-III).
4. Able to design signal conditioning circuit for various transducers (Unit-IV).
5. Able to identify or choose a transducer for a specific measurement application (Unit-V).

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓				✓			
CO2	✓	✓		✓	✓							
CO3	✓	✓	✓						✓			
CO4		✓	✓		✓				✓		✓	
CO5	✓		✓						✓			✓

18EIOESCN	TEST AND MEASURING INSTRUMENTS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- The course is designed is make the students familiar with test and measuring instruments commonly used.

Unit–I

Electrical measurements: General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron instruments. Extension of instrument range: shunt and multipliers, CT and PT.

Unit–II

Measurement of Power: Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.

Unit–III

Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

Unit–IV

Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram Study of digital voltmeter, Digital multimeter, Digital LCR meter, Q-Meter, Digital wattmeter and energy meters.

Unit–V

CRO, DSO, Function generator, Audio frequency signal generation, Waveform analyzers, Spectrum analyzers.

TEXT BOOKS

1. David A. Bell, Electronic Instrumentation and Measurements, OxfordUniversity Press, 3rd Edition, 2013.
2. Shawney A K, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons. 19th revised edition, 2013.

REFERENCES

1. Cooper, W.D. and Helfric , A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1st Edition, 2009.
2. Kalsi.H.S, Electronic Instrumentation, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2012.
3. Golding, E.W. and Widdis, F.C., Electrical Measurements and Measuring Instruments, A.H.Wheeler and Co, 5th Edition, 2011.

COURSE OUTCOMES

At the end of the course the student will be

1. Familiar with various measuring instruments (ammeters, voltmeters, wattmeters, energy meters extension of meters, current and voltage transformers) used to detect electrical quantities. (Unit I & II)
2. Able to design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement. (Unit-III)
3. Able to understand the analog and digital measurements (Unit-IV).
4. Familiar with the operation and usage of various analyzing instruments. (Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓				✓			
CO2	✓	✓	✓								✓	
CO3	✓	✓							✓			
CO4	✓		✓		✓				✓			✓

18EIOESCN	**MEASUREMENTS IN PROCESS INDUSTRIES**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- To expose the students to various measurement techniques used for the measurement of temperature, flow, pressure and level in process industries.

Unit–I

Temperature measurement: Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and its measuring circuits, Radiation pyrometers and thermal imaging.

Unit–II

Pressure measurement: Introduction, definition and units, Mechanical, Electro-mechanical pressure measuring instruments. Low pressure measurement, Transmitter definition types, I/P and P/I Converters.

Unit–III

Level measurement: Introduction, Mechanical and electrical methods of level measurement.

Unit–IV

Flow measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters, Hot wire anemometer and ultrasonic flow meters.

Unit–V

Calibration and selection of Flow meters

TEXT BOOKS

1. Doebelin E.O., Measurement Systems - Application and Design, Tata McGraw Hill publishing company, 5th Edition, 2008.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.

REFERENCES

1. B.E.Noltingk, Instrumentation Reference Book, 2ndEdition, Butterworth Heinemann, 1995.
2. B.G.Liptak, Process Measurement and Analysis, 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
3. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, 5th Edition, McGraw Hill, Singapore, 1999.
4. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001.
5. Spitzer D. W., Industrial Flow measurement, ISA press, 3rd Edition, 2005

COURSE OUTCOMES

At the end of the course the students will be able to

1. Familiar with the different temperature measurement techniques used in process industries. (Unit-I)
2. Able to understand the working principle of different pressure transmitters and level sensors used in industries. . (Unit-II)
3. Able to identify or choose temperature, flow, pressure and level measuring device for specific process measurement. (Unit-III & IV)
4. Familiar with various flow instrumentation used in industrial flow measurement.(Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓			✓					✓			
CO2	✓			✓	✓							
CO3	✓	✓	✓	✓	✓				✓			✓
CO4			✓	✓								✓

18EIOESCN	**INDUSTRIAL AUTOMATION AND CONTROL**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.

Unit–I

Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

Unit–II

Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction- Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

Unit–III

Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

Unit–IV

Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements .

Unit–V

Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Fieldbus and Profi bus – Application and case studies of large scale process control using DCS.

TEXT BOOKS

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 5th Edition, Prentice Hall Inc., New Jersey, 2002.
2. Frank D. Petruzella, Programmable Logic Controllers, 4th Edition, McGraw Hill, New York, 2010.

REFERENCES

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Prentice Hall, New Delhi, 2005.
3. Krishna Kant, Computer-based Industrial Control, 2nd edition, Prentice Hall, New Delhi, 2011.
4. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Design and development of PLC ladder programming for simple process applications. (Unit I & II)
2. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system. (Unit III)
3. Understand the popular process automation technologies(Unit IV)
4. Know the latest communication technologies like HART and Field bus protocol (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓				✓			
CO2	✓	✓		✓							✓	
CO3	✓	✓			✓							✓
CO4	✓	✓		✓	✓				✓			

18EIOESCN	NANO MATERIALS AND NANO ELECTRONICS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students about the basics of Nanotechnology and its applications.
- To provide adequate knowledge on Nanomaterial properties, Quantum Mechanics and Nano electronics.
- To expose the knowledge on Nano electronics devices and its applications.

Unit–I

Introduction to nanomaterials - Preparation/Synthesis: History of nanomaterials - Influence on properties by "nano - structure induced effects" - Some present and future applications of Nanomaterials, Approaches for synthesis of nanostructures - Processes for producing ultrafine powders - Chemical Synthesis - Physical Synthesis – Bio mimetic processes.

Unit–II

Characterization and Properties of Nanomaterials: Structural Characterization - X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy, Scanning probe microscopy - Mechanical - Introduction - Property changes due to nanostructuring - Strengthening and Toughening Mechanisms – Chemical – Sensors – catalysis – Magnetic- Magnetic Properties of small atomic clusters – Why interest in nano-scale magnetic materials- Classifications of magnetic nanomaterial – Optical-Absorption of light in semiconductor materials - Optical properties of a translucid object.

Unit-III

Quantum Mechanics: Schrodinger – Time Dependent / Independent Equation-Electron to Electron Interactions-Differential to Matrix Equation-Choosing Matrix Parameters-Non-Equilibrium Green's Functions (NEGF)-Conductance Functions for Coherent Transport-Elastic Dephasing-Quantum of Conductance-2D Conductor as ID Conductors in Parallel.

Unit–IV

Fundamentals of Nano Electronics: The New Ohm's Law-The Bottom-Up Approach-Electrons Flow-Ballistic and Diffusive Transport-Diffusion Equation for Ballistic Transport-Conductivity, Drift-electrostatics- smart contacts. Nano transistors-current equation, physics of Ballistic MOSFET – characteristics.

Unit–V

Carbon Nanotubes :Graphene band structure, properties. Synthesis of Carbon Nanotubes – The Structure of Carbon Nanotubes, Carrier Concentration – Electronic properties of Nanotubes – Electron Transport in ballistic conductor –

Carbon Nanotube Electronics: Theory of CNT P-N junction - Carbon Nanotube Transistors – density of states - Schottky Barrier – Ohmic Contacts– Schottky Contacts –Subthreshold Short- Channel Effects.

TEXT BOOKS

1. Nanostructures &Nanomaterial: Synthesis, Properties and Applications, Guozhong Cao, Imperial College Press - World Scientific Publishing Co. Ltd, London - 2004.
2. Lessons from Nano electronics. A New Perspective on Transport-
3. SupriyoDatta, Purdue University, USA, 2012.

REFERENCES

1. Janos H. Fendler, Nanoparticles and Nanostructured films: Preparation, Characterization and Applications, ISBN: 3527294430, Wiley VCH, 1998.
2. Kenneth J. Klabunde, Nanoscale materials in chemistry, ISBN: 0471383953, John Wiley &Sons, 2001.
3. Zhon Ling Wang, Characterization of Nano phase materials, ISBN: 3527298371, Wiley-VCH Verlag GmbH, 2000.
4. The physics of Carbon Nanotube Devices, ISBN: 978-0-8155-1573-9 François Léonard, 2009 by William Andrew.

COURSE OUTCOMES

1. Will get to know the future of electronics and its applications. (Unit I, II & IV)
2. Updates the students with the recent advancements in the nanotechnology. (Unit I, II & IV)
3. To introduce the students the concepts of quantum mechanics for analysis of nanoelectronic devices. (Unit III)
4. To understand Nano-material (Unit V)

Mapping of Cos with Pos												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2		✓										✓
CO3			✓									
CO4		✓								✓		

18EIOESCN	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students to the fundamentals Micro electromechanical systems.
- To teach the fundamental concepts MEMS Fabrication process.
- To study the design concepts of MEMS devices.
- To compare types and Functionalities of various methods of micromachining.

Unit–I : Miniaturization of Systems

Need for miniaturization, Microsystems versus MEMS, Need for micro fabrication, smart materials, Structure and Systems, Application of smart material and Micro system. Scaling in mechanical domain, Scaling in Electrostatic domain, Scaling in thermal domain.

Unit–II : Micromachining Technology

Silicon as a material for micromachining-Crystal Structure , Silicon Wafer Preparation- Thin Film Deposition –Evaporation, Sputtering, CVD, Epitaxial Growth, Thermal Oxidation-Lithography – Photolithography , Lift-Off Techniques-Etching – Isotropic Etching, Anisotropic Etching, Etch Stops, Dry Etching - Silicon Micromachining – Bulk , Surface Micromachining – Specialized Materials for Microsystems-Polymers, Ceramic Materials- Advanced Process Of Micro fabrication-Wafer Bonding Techniques, Special Micro fabrication Techniques.

Unit–III : Silicon Capacitive Accelerometer

Overview, advantages of silicon capacitive accelerometer , typical applications, an example of a prototype, material used, fabrication process, principle of operation.

Piezoresistive pressure sensor**:** overview, advantages of piezoresistive pressure sensor, typical applications, material used, fabrication process, principle of operation, An example commercial Products.

Unit–IV : Modelling of Solids in Microsystems

The simplest Deformable Element: a bar- Transversely deformable Element: a beam- energy methods for elastic bodies- Bimorph effects.

Unit–V : MEMS Actuators and their Applications

Actuation mechanisms – Electrostatic actuation – Electrostatic cantilever actuators – Electrostatic comb drives – Feedback stabilization of electrostatic actuators - lectrostatic micro grippers – Electrostatic relays and switches - Thermal actuation – Thermal expansion of solids – Thermal array actuators –Piezoelectric actuation.

TEXT BOOKS

1. G.K.Ananthasuresh, K.J.Vinoy,S.Gopalakrishnan, K.N.Bhat,V.K.Aatre, Micro and smart systems.
2. Tai-Ran-Hsu, MEMS & Microsystems Design and Manufacture, Tata McGrawHill, New Delhi, 2002.

REFERENCES

1. Stephen D. Senturia, Microsystem Design, Springer International Edition, 2001.
2. Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International,2006.
3. S.M. Sze, Semiconductor Sensors, John Wiley and Sons, 1994.
4. Gregory T.A. Kovacs, Micro machined Transducers, WCB McGraw Hill, 1998.

COURSE OUTCOMES

At the end of the course the students will be able to

1. The fundamentals of Micro electromechanical systems and their applications will be studied. (Unit I)
2. The fundamental concepts of MEMS Fabrication process will be gained. (Unit II)
3. The design concepts of MEMS devices will be developed. (Unit II, III & IV)
4. The Functionalities of various methods of micromachining involved in different MEMS devices will be studied. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓									
CO2					✓							
CO3					✓							
CO4			✓									

18EIOESCN	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	-	-	3

Course Objectives

- To understand the operations of petrochemical industries.
- To be familiar with the control loops in petrochemical industries.

Unit-I : Oil extraction and processing

Techniques used for oil discovery - seismic survey - methods of oil extraction - oil rig system - Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator - scrubber – coalescer

Unit-II :Petroleum refining

Petroleum refining process - unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum

Unit-III :Chemicals from petroleum

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC

Unit-IV :Control loops in petrochemical industry

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

Unit-V :Safety in instrumentation systems

Area and material classification as per National Electric Code (NEC) - Classification as per International Electrotechnical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Type X, Type Y and Type Z - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit

TEXT BOOKS

1. Balchen J.G and Mumme K.I., Process Control Structures and Applications, Von Nostrand Reinhold Company, New York, 1988.
2. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005

REFERENCES

1. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd., 1968.
2. Ram Prasad, Petroleum Refining Technology, Khanna Publishers, New Delhi, 2000.
3. www.scribd.com/doc/2336259/ABB-Oil-Gas-production-Hand-Book

Course Outcomes

At the end of the course the students will be able to

1. Understand the principle and working of Oil Industries.(Unit I)
2. Understand the refining process in Oil Industries (Unit II)
3. To know the petroleum by-products.(Unit III)
4. Analyse the control loops in petrochemical industries.(Unit IV)
5. To know the safety in instrumentation systems.(Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓					✓	✓			
CO2	✓				✓					✓		
CO3	✓	✓		✓	✓		✓				✓	
CO4	✓			✓	✓		✓	✓	✓			
CO5	✓		✓	✓				✓	✓			✓

HONOUR ELECTIVES

18EIHESCN	ADVANCED TOPICS IN PID CONTROL	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- To provide knowledge about the advances in PID controller and adaptive PID control.
- To acquire knowledge in the basics of PID controller and Anti-windup strategies.
- To study about PID controller design and robust performance.
- To understand the need for Adaptive PID control.

Unit–I : Basics of PID Control

Introduction-feedback control-On-Off control-Three actions of PID control-Proportional, Integral and Derivative actions-Structure of PID controllers-Modifications of the basic PID control law-Problems with derivative action-set point weighting-General ISA-PID control law-Digital implementation-Choice of the controller type. Derivative filter design: Introduction-The significance of the filter in PID design-Ideal Vs series form-Simulation using Matlab.

Unit–II : Anti-Windup Strategies and Setpoint Weighting

Introduction-Integrator windup-Anti-windup techniques-Avoiding saturation-conditional Integration-Back-calculation-combined approaches-Automatic reset implementation- Simulation using Matlab.

Set point Weighting: Introduction-Constant set point weight design-Variable set point weighting: Methodology- Simulation using Matlab.

Unit–III : PID Controller Design

ZN and related methods- rule based empirical tuning- pole placement- lambda tuning- algebraic design- optimization methods- robust loop shaping and frequency response methods- IMC based PID tuning- Design for disturbance rejection.

Unit–IV : Robust Performance and Performance Assessment

Modeling uncertainty-performance in the presence of uncertainty-robust pole placement design for robust performance- PID controller performance assessment.

Unit–V : Adaptive PID Control

Auto tuning- Adaptive Technique-model based methods-rule based methods-Multi model based PID Controller design- nonlinear PID Controller design.

TEXT BOOKS

1. Antonio Visioli, Practical PID Control, Springer, 2006.
2. Karl J. Astrom and Tore Hagguland, Advanced PID Control, ISA Publications,2005.

REFERENCE BOOKS

1. G.J. Silva, Aniruddhadatta, SP.Bhattacharyya, PID control for time delay systems, Springer, 2005.
2. Q.G. Wang, Z. Ye, W.J. Cai, C.C. Hang, PID control for Multivariable Process, Springer, 2008.
3. Karl J. Astrom and Tore Hagguland, PID Controllers: Theory, Design and Tuning, Second edition, ISA Publications, 1995.

COURSE OUTCOMES

At the end of the course the students will be able to:

1. Understand the basics of PID control.(Unit I)
2. Implement Anti-windup strategies.(Unit II)
3. Design a PID controller.(Unit III)
4. Understand the robust performance.(Unit–IV)
5. Understand the need for Adaptive PID control. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								✓
CO2		✓	✓	✓								
CO3		✓	✓	✓	✓						✓	
CO4		✓	✓	✓								
CO5		✓	✓	✓								✓

18EIHESCN	INDUSTRIAL SAFETY	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To provide the concept of Industrial Safety & provide knowledge for workplace safety
- To acquire knowledge in identification, evaluation and control of all the hazards
- To prevent harm or damage to people, property, or the environment.

Unit-I: Industrial safety

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light,

cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi.Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Higgins &Morrow, Maintenance Engineering Handbook, Da Information Services, 1994.
2. H. P. Garg, Maintenance Engineering, S. Chand & Company Ltd, 2012

REFERENCES

1. Frank D Graham, Audels Pumps-Hydraulic Air Compressors, Mcgraw Hill Publication, 1949.
2. Fang, Hsai-Yang,Foundation Engineering Handbook, Chapman & Hall, London

COURSE OUTCOMES

At the end of the course the students will be able to:

1. Identify hazard and potential hazard areas Unit I)
2. Develop safety programs to prevent or mitigate damage or losses (Unit II)

3. Assess safety practices and programs.(Unit III)
4. Conduct safety audits.(Unit–IV)
5. Improve safety practices. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓				✓	✓		✓
CO2				✓								
CO3				✓	✓				✓	✓		✓
CO4					✓							✓
CO5				✓	✓				✓			✓

18EIHESCN	ROBOTICS AND AUTOMATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the basic anatomy of robots and trajectory planning list of objectives about the course
- To enable students to understand about the work envelopes of robots and its role in automation
- To give an overview of the various methods of control of robots
- To select robots based on their applications and their related issues in industrial automation

Unit–I :Fundamentals of Robots

Definition –Historical background- Robot Anatomy : Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration–Work volume– Robot Drive System : Hydraulic, Electric, Pneumatic – Control System: Limited sequence, Play back with point to point and Continuous path control Intelligent Robots- Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance – Introduction to End effectors, Robotic Sensors, Robot Programming and work cell control.

Unit–II :Robot End Effectors, Sensors

End Effectors: Types-Mechanical grippers-Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops- Tools as end effectors - Robot/ End-effectors interface- Consideration in Gripper selection and Design.

Sensors: Transducers and Sensors – Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor based systems- Machine Vision System.

Unit–III :Programming and Control of Robots

Robot Programming: Methods of Programming-: Leadthrough Methods, Robot program as a path in space- Motion interpolation, WAIT, SIGNAL and DELAY Commands, Branching, Capabilities and limitations of Leadthrough Methods- Textual Robot Programming- structure, Motion, End effectors and Sensor commands, Program control communication, Monitor mode commands

Robot Control: Open and Closed loop control- control Problem- Linear control Schemes- Design of Partitioned PD, PID and Adaptive Controllers for Linear Second order SISO Model of robot and their Block schematic representation- Control of Industrial Robots Using PLCs.

Unit–IV :Automation

Factory Automation: Fixed Automation, Flexible Automation and Programmable Automation. Intelligent Industrial Automation, Industrial Networking, Bus Standards

Automatic Feeders, Automatic Storage and Retrieval Systems (AS/RS), Transfer Lines, Automatic Inspection Systems

Unit–V :Applications of Robots

Factors influencing the selection of Robots – Robots for Welding, Painting, Assembly, Nuclear, Thermal and Chemical Plants.

Introduction to Mobile Robots, Legged Robots and Remote Controlled Robots, Automated Guided Robots, Micro Robots – Control and Safety Issues.

TEXT BOOKS

1. Groover, M.P., Weiss, M., Nagel, R.N., Odrey, N.G., Industrial Robots: Technology, Programming and Applications, McGraw-Hill Book Company, 2012.
2. Mittal R K, Nagrath I J, "Robotics and control", Tata McGraw Hill, 2010.

REFERENCES

1. Groover, M.P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice-Hall of India Private Limited, New Delhi, 2007
2. S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994
3. Yoran Koren, Robotics for Engineers, McGraw Hill, 1980.
4. Saeed B. Niku, An Introduction to Robotics- Analysis, Systems, Applications, Second Edition, John Wiley & Sons Inc., 2010.
5. Wesley, E. Sryda, "Industrial Robots: Computer interfacing and Control" PHI, 1985.

COURSE OUTCOMES

At the end of the course the student will be able to

1. Expertise in fundamentals of Robotics (Unit I)
2. Understand the issues related to end effectors and sensors (Unit II)
3. Acquire knowledge in Programming and control of Robots (Unit III)
4. Understand the issues related to implementation of Industrial Automation with Robot Application (Unit–IV :)
5. Gain an in depth understanding of the selection of robots for various application and their safety issues (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓										✓	
CO2	✓											
CO3				✓								
CO4		✓										
CO5					✓						✓	✓

18EIHESCN	FIBER OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To provide basic knowledge of optical fibers and their properties.
- To expose adequate knowledge about the Industrial applications of optical fibers.
- To disseminate the students, the fundamental characteristics, types and industrial applications of optical laser.
- To provide adequate facts about holography and medical applications of optical laser.

Unit–I

Principles of light propagation through a fiber - Basic optical laws and definitions - Different types of fibers and their properties, fiber characteristics – Wave Propagation-Fiber Losses– Dispersion – Connectors and splicers – Optical sources and detectors.

Unit-II

Fiber optic sensors – Measurement of pressure, temperature, current, voltage and liquid level – Polarimetric fiber sensor – Interferometric method of measurement of length – Moire fringes - Optical Multiplexer.

Unit–III

Laser Principles: Absorption process – Emission process - Fundamental characteristics of lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching – Types of lasers: Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

Unit–IV

Laser for measurement of distance, length, velocity, acceleration and current, voltage – Material processing: Laser heating, welding, melting and trimming of material – Laser spectroscopy.

Unit–V

Holography - basic principles - Holography for NDT - medical application of lasers: laser and tissue interaction, laser instruments for surgery, removal of tumors of vocal chords, brain surgery, plastic surgery, gynecology, and oncology.

TEXT BOOKS

1. Keiser, Optical Fiber Communication Systems, McGraw Hill Ltd., 2008.
2. S.Nagabhushana and N.Sathyanarayana, Lasers and Optical Instrumentation, I.K.International publishing, 2010.

REFERENCES

1. Govind P. Agrawal, Fiber-Optic Communication Systems, 4th Edition, Wiley publication, 2010.
2. Pallab Bhattacharya, Semiconductor Opto-Electronics, PHI, 2002.
3. John and Harry, Industrial lasers and their application, McGrawHill,2002.
4. Introduction to H pology raphy, CRC press, 2012.

COURSE OUTCOMES

1. Understand the Characteristics and properties of optical fibers. (Unit I)
2. Use of optical fibers in industries. (Unit II)
3. Identify the characteristics and principles of optical lasers. (Unit III)
4. Development of optical laser in industry applications. (Unit–IV :)
5. Applications of lasers in medical electronics. (Unit V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓	✓										✓
CO3	✓	✓			✓						✓	
CO4	✓	✓	✓									
CO5	✓	✓	✓		✓						✓	✓

18EIHESCN	PROCESS DATA ANALYTICS	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- To impart knowledge on various Non-parametric approaches based system identification.
- To make the student understand the principles of State space modelling of linear and nonlinear systems.
- To know non-recursive and recursive parametric identification approaches and to develop robust parametric identification methods.
- To impart knowledge pertaining to practical aspects of system identification and control.

Unit-I Process Identification

(Non-Parametric methods): Transient response analysis - frequency response analysis - correlation analysis - State space modeling of systems - Nonlinear state space model and linearization of nonlinear models ; Modeling in state space - state space models – canonical state space forms- mechanical systems –Electrical systems – Liquid level systems- Thermal systems. State estimation using Kalman Filter-extended Kalman filter – unscented kalman filter-ensemble kalman filter for parameter Identification.

Unit – II Discrete time system models for control:

ARX models - bilinear parametric models – ARMAX,OE,BJ models - Hammerstein models – Wienner model –prediction error method and instrumental variable method . Selection of pseudo random binary sequence.

Unit – III Recursive Plant Model identification in open-loop:

Identification methods - least squares - recursive least squares - extended least squares – generalized least squares –weighted LSE-maximum likelihood method - model validation identified in open-loop – Model order selection.

Unit – IV Recursive plant model identification in closed-loop:

Identification methods - closed-loop output error algorithms - filtered closed-loop error algorithms - filtered open-loop identification algorithms - model

validation identified in closed-loop - comparative evaluation of various algorithms. Subspaces identification method: classical and innovation forms, free and structures parameterizations- relay feedback identification of stable processes and unstable processes.

Unit – V Nonlinear system identification:

Modeling of nonlinear system using ANN- NARX, NNSS,NARMAX- generation of training data – training Feed-Forward and Recurrent Neural Networks- TSK model-Adaptive Neuro-Fuzzy Inference system(ANFIS), Practical aspects of System identification and control: Selection of input signals - offline and online identification; notion for persistent excitation,drifts and de-trending-outliers and missing data-pre-filtering-robustness – comparison of parameter estimation methods – model order testing and verification- case studies.

TEXT BOOKS

1. Ioan D. Landau and GianlucaZito, Digital Control Systems, Design, Identification and Implementation, Springer-Verlag London Limited 2006.
2. Arun K. Tangirala, " Principles of System Identification: Theory and Practice", CRC Press. 2014.

REFERENCES

1. F.Van der Heijden, R.P.W.DUIN, D.de Ridder and D.M.J. Tax, "Classification, Parameter Estimation and State Estimation , An Engineering Approach Using MATLAB, John Wiley & Sons Ltd. 2004.
2. W.T.Miller, R.S.Sutton and P.J.Webrose, " Neural Networks for Control",MIT Press,1995.
3. Dan Simon, "Optimal State Estimation Kalman,H-infinity and Non-linear Approaches", John Wiley and Sons, 2006.

COURSE OUTCOMES

Students will be able to:

1. Will be able to identify a suitable continuous time domain identification method for the taken up process. (Unit – I)
2. Ability to select particular state space model based on specific control engineering problem. (Unit – II)
3. Understand and implement the various complexity estimation methods, offline and online, open and closed loop estimation methods for modelling and estimating a process. (Unit – III)
4. Gain an idea for robust parameter estimation. (Unit – IV)
5. Select a specific identification method with an approximately equal complexity for the case studies. (Unit – V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓		✓				✓			
CO2		✓	✓		✓							✓
CO3	✓			✓							✓	
CO4		✓	✓		✓							
CO5		✓	✓	✓					✓			✓

18EIHESCN	SCADA SYSTEMS AND APPLICATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

Students will be able to:

- To understand what is meant by SCADA and its functions.
- To know SCADA communication.
- To get an insight into its application.

UNIT – I: Introduction to SCADA

Data acquisition systems, Evolution of SCADA, Communication technologies - Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

UNIT – II: SCADA System Components

Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT – III: SCADA Architecture

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850.

UNIT – IV:SCADA Communication

SCADA Communication: various industrial communication technologies - wired and wireless methods and fiber optics. Open standard communication protocols.

UNIT – V: SCADA Applications

SCADA Applications: Utility applications- Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises.

TEXTBOOKS

1. Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of AmericaPublications,USA,2004.
2. Gordon Clarke, Deon Reynders: “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes Publications, Oxford,UK,2004.

REFERENCES

1. William T. Shaw, “Cyber security for SCADA systems”, Penn Well Books,2006.
2. David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes,2003.
3. Wiebe, “A guide to utility automation: AMR, SCADA, and IT systems for electric power”, Penn Well1999.

COURSE OUTCOMES

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications. (Unit-I)
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system. (Unit-II)
3. Knowledge about single unified standard architecture IEC61850. (Unit-III)
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server. (Unit-IV)
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc. (Unit-V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓							✓		
CO3	✓			✓								✓
CO4		✓	✓								✓	
CO5		✓	✓	✓								✓

MINOR ENGINEERING

18EIMISCN	TRANSDUCER ENGINEERING	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers
- To introduce advances in sensor technology

Unit I

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

Unit II

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement.

Unit III

Self and mutual inductive transducers- capacitive transducers, eddy current transducers, proximity sensors, tacho generators and stroboscope.

Unit-IV

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers, Basics of Gyroscope.

Unit-V

Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

TEXT BOOKS

1. John P. Bentley, Principles of Measurement Systems, Pearson Education, 4th Edition, 2005.
2. Doebelin E.0, Measurement Systems - Application and Design, McGraw-Hill, 4th Edition, 2004.

REFERENCES

1. Murthy D. V. S, Transducers and Instrumentation, Prentice Hall, 2nd Edition, 2011.
2. James W.Dally, Instrumentation for Engineering Measurements, Wiley, 2nd Edition, 1993.
3. John G.Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition, 2008.
4. S.M. Sze, Semiconductor sensors, John Wiley & Sons Inc., 1994.

COURSE OUTCOMES

At the end of this course, students be able to

1. Familiar with the basics of measurement system and its input, output configuration of measurement system (Unit-I).
2. Familiar with both static and dynamic characteristics of measurement system (Unit-II)..
3. Familiar with the principle and working of various sensors and transducers. (Unit-III).
4. Able to design signal conditioning circuit for various transducers (Unit-IV)..
5. Able to identify or choose a transducer for a specific measurement application (Unit-V).

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓				✓			✓
CO2	✓	✓		✓	✓							
CO3	✓	✓	✓						✓		✓	
CO4		✓	✓		✓				✓			
CO5	✓		✓						✓			✓

18EIMISCN	TEST AND MEASURING INSTRUMENTS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- The course is designed is make the students familiar with test and measuring instruments commonly used.

Unit–I

Electrical measurements: General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron instruments. Extension of instrument range: shunt and multipliers, CT and PT.

Unit–II

Measurement of Power: Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.

Unit–III

Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

Unit–IV

Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram Study of digital voltmeter, Digital multimeter, Digital LCR meter, Q-Meter, Digital wattmeter and energy meters.

Unit–V

CRO, DSO, Function generator, Audio frequency signal generation, Waveform analyzers, Spectrum analyzers.

TEXT BOOKS

1. David A. Bell, Electronic Instrumentation and Measurements, OxfordUniversity Press, 3rd Edition, 2013.
2. Shawney A K, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons. 19th revised edition,2013.

REFERENCES

1. Cooper, W.D. and Helfric , A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1st Edition, 2009.
2. Kalsi.H.S, Electronic Instrumentation, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2012.
3. Golding, E.W. and Widdis, F.C., Electrical Measurements and Measuring Instruments, A.H.Wheeler and Co, 5th Edition, 2011.

COURSE OUTCOMES

At the end of the course the student will be

1. Familiar with various measuring instruments (ammeters, voltmeters, wattmeters, energy meters extension of meters, current and voltage transformers) used to detect electrical quantities. (Unit I & II)
2. Able to design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement. (Unit-III)
3. Able to understand the analog and digital measurements (Unit-IV).
4. Familiar with the operation & usage of various analyzing instruments. (Unit-V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓				✓			✓
CO2	✓	✓	✓								✓	
CO3	✓	✓							✓			
CO4	✓		✓		✓				✓			✓

18EIMISCN	MEASUREMENTS IN PROCESS INDUSTRIES	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- To expose the students to various measurement techniques used for the measurement of temperature, flow, pressure and level in process industries.

Unit–I

Temperature measurement: Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and its measuring circuits, Radiation pyrometers and thermal imaging.

Unit–II

Pressure measurement: Introduction, definition and units, Mechanical, Electro-mechanical pressure measuring instruments. Low pressure measurement, Transmitter definition types, I/P and P/I Converters.

Unit–III

Level measurement: Introduction, Mechanical and electrical methods of level measurement.

Unit–IV

Flow measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters, Hot wire anemometer and ultrasonic flow meters.

Unit–V

Calibration and selection of Flow meters

TEXT BOOKS

1. Doebelin E.O., Measurement Systems - Application and Design, Tata McGraw Hill publishing company, 5th Edition, 2008.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.

REFERENCES

1. B.E.Noltingk, Instrumentation Reference Book, 2ndEdition, Butterworth Heinemann, 1995.
2. B.G.Liptak, Process Measurement and Analysis, 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
3. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, 5th Edition, McGraw Hill, Singapore, 1999.
4. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001.
5. Spitzer D. W., Industrial Flow measurement, ISA press, 3rd Edition, 2005

OURSE OUTCOMES

At the end of the course the students will be able to

1. Familiar with the different temperature measurement techniques used in process industries. (Unit-I)
2. Able to understand the working principle of different pressure transmitters and level sensors used in industries. . (Unit-II)
3. Able to identify or choose temperature, flow, pressure and level measuring device for specific process measurement. (Unit-III & IV)
4. Familiar with various flow instrumentation used in industrial flow measurement.(Unit-V)

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓					✓			✓
CO2	✓			✓	✓							
CO3	✓	✓	✓	✓	✓				✓		✓	
CO4			✓	✓								✓

18EIMISCN	ESSENTIALS OF CONTROL ENGINEERING	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- To expose the students to the fundamentals of feedback control system.
- To analyse variety of classical control schemes using simulation software

Unit-I

Introduction to control system – Open loop and Closed loop system – Feedback system characteristics – Block diagram reduction techniques – Signal flow graph.

Unit-II

Order and type of system – time domain and frequency domain response of different system characteristics using simulation software – Introduction of stability – Routh Hurwitz stability criteria.

Unit-III

Introduction to root locus – plotting of root locus and stability analysis using simulation software. Introduction to bode and Nyquist plot – Plotting of bode and Nyquist plot using simulation software - Gain Margin and Phase margin calculation.

Unit-IV

Introduction to different compensator design – the design of different compensator design using simulation software.PID controller design using simulation software.

Unit-V

Application of control system for different domain with case studies.

TEXT BOOKS

1. J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New Age International (P) Ltd., Publishers, 2009.
2. M. Gopal, Control Systems Principles and Design, McGraw-Hill Education, Fourth edition, 2012.

REFERENCES

1. B. C. Kuo, Automatic Control Systems, Prentice Hall of Indian, Sixth Edition, 1991.
2. K. Ogata, Modern Control Engineering, Prentice Hall India Learning Private Limited,
3. Fifth Edition, 2010.
4. K. Ogata, Solving Control Engineering Problems with MATLAB, Prentice Hall, 1994.

COURSE OUTCOMES

At the end of the course the students will be able to

1. The student learns the importance of feedback control system. (Unit-I)
2. The student understands time domain and frequency domain techniques using simulation software. (Unit-II & III)
3. The student is exposed to classical control design using simulation software (Unit IV & V).

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓				✓			✓
CO2		✓	✓	✓	✓				✓		✓	
CO3		✓	✓	✓	✓				✓			✓

18EIMISCN	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.

Unit–I

Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

Unit–II

Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction- Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

Unit–III

Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

Unit–IV

Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements .

Unit–V

Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Fieldbus and Profi bus – Application and case studies of large scale process control using DCS.

TEXT BOOKS

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 5th Edition, Prentice Hall Inc., New Jersey, 2002.
2. Frank D. Petruzella, Programmable Logic Controllers, 4th Edition, McGraw Hill, New York, 2010.

REFERENCES

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Prentice Hall, New Delhi, 2005.
3. Krishna Kant, Computer-based Industrial Control, 2nd edition, Prentice Hall,New Delhi, 2011.
4. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Design and development of PLC ladder programming for simple process applications.
2. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system.
3. Understand the popular process automation technologies
4. Know the latest communication technologies like HART and Field bus protocol

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓				✓			
CO2	✓	✓		✓								
CO3	✓	✓			✓							
CO4	✓	✓		✓	✓				✓			

18EIMISCN	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	-	-	3

Course Objectives

- To understand the operations of petrochemical industries.
- To be familiar with the control loops in petrochemical industries.

Unit-I :Oil Extraction and Processing

Techniques used for oil discovery - seismic survey - methods of oil extraction - oil rig system - Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator - scrubber – coalesce.

Unit-II :Petroleum Refining

Petroleum refining process - unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum

Unit-III :Chemicals from Petroleum

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC

Unit-IV :Control Loops in Petrochemical Industry

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

Unit-V :Safety in Instrumentation Systems

Area and material classification as per National Electric Code (NEC) - Classification as per International Electrotechnical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Type X, Type Y and Type Z - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit.

TEXT BOOKS:

1. Balchen J.G and Mumme K.I., Process Control Structures and Applications, Von Nostrand Reinhold Company, New York, 1988.
2. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005.

REFERENCES

1. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd., 1968.
2. Ram Prasad, Petroleum Refining Technology, Khanna Publishers, New Delhi, 2000.
3. www.scribd.com/doc/2336259/ABB-Oil-Gas-production-Hand-Book

Course OutComeS

At the end of the course the students will be able to

1. Understand the principle and working of Oil Industries.(Unit I)
2. Understand the refining process in Oil Industries (Unit II)
3. To know the petroleum by-products.(Unit III)
4. Analyse the control loops in petrochemical industries.(Unit IV)
5. To know the safety in instrumentation systems.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓					✓	✓			
CO2	✓				✓							✓
CO3	✓			✓	✓		✓					
CO4	✓	✓		✓	✓		✓	✓	✓		✓	✓
CO5	✓		✓	✓				✓	✓			

❑