ANNAMALAI UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (Full-Time)
(Choice Based Credit System)
REGULATIONS 2022

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 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.

2. Branches of Study in B.E.

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

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 Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core, Professional/Programme Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a

blend of theory, practical and theory cum practical courses. The total credits for the entire degree Programme is **173 (132** 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 earn a minimum of 173 credits (132 for lateral entry students).

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

5.1 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 193. Out of 193 credits (152 credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure) in the fifth, sixth and seventh semesters.

5.2 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 193 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure) in the Faculty of Engineering and Technology in fifth, sixth and seventh semesters.

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 173 (132 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 study and 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 VII semester 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 Advanced Learners

The **advanced 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. 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.

10. 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 entire duration of the program.

- 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

11. Electives

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

11.1 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.

11.2 Open Elective Courses

Apart from the various Professional elective courses, a student must study **five** open elective courses of which the student may opt to study either that offered by the Department concerned or from the open elective courses offered by any other Department in the Faculty of Engineering & Technology, with the approval of the Head of the concerned Department and the Head of the Department offering the course. In case the student opts to study an open elective offered by a neighbouring Department in the Faculty, it shall be handled by the faculty of that Department offering the chosen open elective.

A student may be required to choose Intellectual Property Rights (IPR) and Cyber Security as open electives anywhere between fifth and eighth semesters as part of the requirements of the study.

11.3 MOOC (SWAYAM) Courses

The student can be permitted to earn not more than 40 % of his/her total credits (that is 69 credits) by studying Massive Open Online Courses (MOOCs) offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned and the Dean of the Faculty. The courses will be considered as equivalent to elective courses from the fifth to the eighth semesters and the credits earned through MOOC courses may be transferred and considered for awarding Degree to the student concerned.

A student who earns 3 or more credits from a 12 week MOOC course through SWAYAM portal (Syndicate Resolution No.:14 dated 10.05.2019) shall be exempted from studying the elective course and permitted to transfer the credits. Besides the student may be permitted to claim for the conversion to the next higher grade in accordance with the Syndicate Resolution No.: 31 dated 09.09.2020

11.4 Value Added Courses

A student can study one or more value added courses being offered by the other Departments of Study either within the Faculty or any other Faculty in the University in any semester of the B.E degree programme except First Year, with the restriction that only one Value added Course can be registered at a time.

11.5 Extra One Credit Courses

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

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 extra 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 extra one credit courses (one each in VI and VII semesters). They shall be allowed to take extra 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 extra one credit courses.

11.6 Skill Related /Naan Mudhalvan

A student is required to study **Three** open elective courses One each in the fifth, sixth and seventh semester of study as part of acquiring skills in the specified field. The student shall pursue the open electives listed in the Naan Mudhalvan portal against the respective semesters. However alternatively the student shall choose the open electives from the list tabled relating to the respective programmes with the approval of the Head of the Department concerned and Dean of the Faculty.

12. Assessment

12.1. Theory Courses

The break-up of Continuous Assessment for the theory courses relates to evaluating the performance under the five Course Outcomes uniformly with 5 Marks for each outcome spread over Two Mid-Semester tests and One Assignment, totalling to 25 Marks. Similarly the break-up mark for University End Semester exams involves evaluating the performance under the five Course Outcomes with 15 Marks for each Outcome, totalling to 75 Marks.

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

First assessment (Mid-Semester Test-I Covering Units I & II)	:	8 marks
Second assessment (Mid-Semester Test-II Covering Units III, IV & V)	:	12 marks
Third Assessment (Assignment Covering Units I, II, III, IV & V)	:	5 marks
End Semester Examination	:	75 marks

The break-up of Continuous Assessment for the theory course titled Basic Engineering in the II semester that involves two disciplines requires evaluating the performance under the five Course Outcomes, with 3 for one discipline and two for the other, uniformly with 5 Marks for each outcome spread over Two Mid-Semester tests and One Assignment, totalling to 25 Marks. Similarly the break-up mark for University End Semester exams involves evaluating the performance under the five Course Outcomes with 15 Marks for each Outcome, totalling to 75 Marks.

12.2 Practical Courses

The break-up of Continuous Assessment for the practical courses involves evaluating the performance under the five Course Outcomes uniformly with 8 Marks for each outcome spread over Two tests and Record work, totalling to 40 Marks. Similarly the break-up mark for University End Semester exams relates to evaluating the performance under the five Course Outcomes with 12 Marks for each Outcome, totalling to 60 Marks

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

First Assessment (Test-I Relating to Cycle I)	:	15 marks
Second Assessment (Test-II Relating to Cycle II)	:	15 marks
Maintenance of Record book	:	10 marks
End Semester Examination	:	60 marks

12.3 Theory cum Practical Course

The break-up of Continuous Assessment for the theory cum practical courses necessitates to evaluating the performance as being followed for the theory and practical courses individually and requires the students to clear each component separately. The average of the marks secured by the student in the theory and practical courses and the appropriate grade relating to the average shall be assigned to the student.

12.4 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.

12.5 Industrial Internship

After attending the internship during the semester vacation of II / III year for a period of 4 weeks duration in each year, the student has to submit a report and appear for the viva-voce exam along with the V/VII semester end semester examinations.

13. 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.

14. 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.

15. 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 of I & II Semester) for approval and transmission to the Controller of Examinations.

16. 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.

17. 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.

18. 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.

19. 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-evaluation 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.

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

20. Awarding Degree

After successful completion of the programme, the degree will be awarded based on OGPA/CGPA.

The conversion of OGPA/CGPA (from I semester to VIII Semester) to the corresponding Percentage of marks may be calculated as per the following formula:

Percentage of marks = (OGPA/CGPA - 0.25) x 10

Where $OGPA/CGPA = \frac{\sum C_i GP_i}{\sum C_i}$

C_i- Credit hours of a course

GP_i - Grade Point of that course

20.1 Honours Degree

The student requires to earn a minimum of 193 credits within four years (152 credits 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 OGPA/CGPA of 8.25 or above to obtain the Honours Degree.

The student is required to complete 6 elective courses, 2 each in the V, VI and VII semesters with a stipulation that 2 of the 6 courses need to be of 4 credits each, while the remaining 4 has to be of 3 credits each, thus totalling to 20 credits, the choice being approved by the Head of the Department concerned and the Dean of the Faculty.

However, if the student either does not clear the extra course(s) relating to become eligible for the Honours Degree or discontinues it in any of the semesters, then the student may revert to the category of the First Class with Distinction or First class, provided the student is eligible for that respective category. The student may claim for revised mark sheet, paying the stipulated fee in order that the unsuccessful appearance or discontinuity of the course(s) is not reflected in the new mark sheet.

20.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 173 Credits within four years (132 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.

20.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 173 credits within ***five*** years (132 credits within ***four*** years for lateral entry students) from the time of admission and obtain a OGPA/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).

20.4 Second Class

For Second Class, the student must earn a minimum of 173 credits within **seven** years (132 credits within **six** years for lateral entry students) from the time of admission.

20.5 B.E Degree with Minor Engineering

The student shall be given an option to earn a Minor Engineering Degree in another discipline of Engineering not related to his/her branch of study at the end of the first year provided the student clears all the subjects in the first year in the first attempt and secures a OGPA/CGPA of not less than 7.5

The student is required to earn an additional 20 credits starting from the third semester in the sense he/she requires to complete 6 elective courses, 2 each in the V, VI and VII semesters with a stipulation that 2 of the 6 courses need to be of 4 credits each, while the remaining 4 has to be of 3 credits each, thus totalling to 20 credits, the choice being approved by the Head of the Department concerned and the Dean of the Faculty.

The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class apply in the same manner for B.E Degree with Minor Engineering.

However the student who opts for Honours Degree is not entitled to pursue B.E Degree with Minor Engineering and vice-versa

21. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of OGPA/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 OGPA/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 OGPA/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.

22. 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.

ANNEXURE

S.No	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
1	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engineering.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering 5. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 6. Computer Science and Engineering(Data Science) 7. Mechanical (Manufacturing) Engineering. 8. Electronics and Instrumentation Engineering. 9. Information Technology 10. Electronics and Communication Engineering.
2	Civil and Structural Engineering		
3	Mechanical Engineering	1. Mechanical Engineering 2. Mechanical (Manufacturing) Engineering.	1. Civil Engineering 2. Civil and Structural Engineering. 3. Electrical Engineering 4. Chemical Engineering 5. Computer Science and Engineering 6. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 7. Computer Science and Engineering (Data Science) 8. Electronics and Instrumentation Engineering. 9. Information Technology 10. Electronics and Communication Engineering.
4	Mechanical (Manufacturing) Engineering.		

S.No	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
5	Electrical and Electronics Engineering	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engineering. 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engineering.
6	Electronics and Instrumentation Engineering.		
7	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engineering. 4. Information Technology 5. Civil and Structural Engineering. 6. Electrical Engineering 7. Electronics and Communication Engineering. 8. Mechanical (Manufacturing) Engineering. 9. Computer Science and Engineering 10. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 11. Computer Science and Engineering(Data Science)
8	Computer Science and Engineering	1. Computer Science and Engineering. 2. Information Technology	1. Civil Engineering 2. Mechanical Engineering 3. Mechanical (Manufacturing) Engineering.

S.No	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
9	Information Technology	1. Electronics and Communication Engineering 2. Computer Science and Engineering(Artificial Intelligence and Machine Learning) 3. Computer Science and Engineering(Data Science)	1. Civil and Structural Engineering. 2. Chemical Engineering
10	Electronics and Communication Engineering.	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engineering. 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engineering.
11	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	1. Computer Science and Engineering. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 5. Computer Science and Engineering (Data Science)	1. Civil Engineering 2. Mechanical Engineering 3. Mechanical (Manufacturing) Engineering. 4. Civil and Structural Engineering. 5. Chemical Engineering
12	Computer Science and Engineering (Data Science)		

DETAILS OF COURSE CODE

S. No	Code (3rd and 4th Digits)	Details	Code (5th and 6th Digits)	Details
1	ET	Common Course for the faculty	HS	Humanities Theory
2	CE	Civil Engg. Course	HP	Humanities Practical
3	CZ	Civil and Structural Engg. course	BS	Basic Science Theory
4	ME	Mechanical Engg. Course	BP	Basic Science Practical
5	MM	Mechanical Engg. (Manufacturing) Course	ES	Engineering Science Theory
6	EE	Electrical and Electronics Engg. Course	SP	Engineering Science Practical
7	EI	Electronics and Instrumentation Engg. course	PC	Professional Core Theory
8	CH	Chemical Engg. course	CP	Professional Core Practical
9	CS	Computer Science and Engg. course	PE	Professional Elective Theory
10	IT	Information Technology course	EP	Professional Elective Practical
11	EC	Electronics and Communication Engg. course	IT	Internship /Industrial Training
12	AI	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	OE	Open Elective Theory
13	DS	Computer Science and Engineering (Data Science)	PV	Project and Viva-voce
14	YY	Code of the Program concerned (S. No 02 to S.No.13)		

The first two digits relate to the year from which the Regulations commence

7th digit represents the semester and 8th and 9th digits represent the serial number of courses.

ANNEXURE – II

SEMESTER I									
Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22ETBS101	BS-I	Mathematics-I	3	1	-	25	75	100	4
22ETBS102	BS-II	Physics	3	1	-	25	75	100	4
22ETBS103	BS-III	Chemistry	3	1	-	25	75	100	4
22ETES104	ES-I	Programming for Problem Solving	2	1	-	25	75	100	3
22ETHS105	HS-I	Heritage of Tamils தமிழர் மரபு	1	-	-	25	75	100	1
22ETHP106	HSP-I	Communication Skills and Language Laboratory	-	-	3	40	60	100	1.5
22ETSP107	ESP-I	Engineering Workshop Practices	-	-	3	40	60	100	1.5
22ETSP108	ESP-II	Electrical Wiring and Earthing Practice Laboratory	-	-	3	40	60	100	1.5
Total Credits									20.5

SEMESTER II									
Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22ETHS201	HS-II	English	3	1	-	25	75	100	4
22ETBS202	BS-IV	Mathematics-II	3	1	-	25	75	100	4
22ETES203	ES-II	Basic Engineering*	4	-	-	25	75	100	4
22ETHS204	HS-III	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	1	-	-	25	75	100	1
22ETBP205	BSP-I	Physics Laboratory	-	-	3	40	60	100	1.5
22ETBP206	BSP-II	Chemistry Laboratory	-	-	3	40	60	100	1.5
22ETSP207	ESP-III	Computer Programming Laboratory	-	-	3	40	60	100	1.5
22ETSP208	ESP-IV	Engineering Graphics	2	-	3	40	60	100	3
								Total Credits	**20.5**

* Basic Civil Engineering (3 Units) & Basic Mechanical Engineering (2 Units) for Circuit Branches
* Basic Mechanical Engineering (2 Units) & Basic Electrical and Electronics Engineering (3 Units) for Civil, C&S and Chemical Engineering Branches
* Basic Civil Engineering (2 Units) & Basic Electrical and Electronics Engineering (3 Units) for Mechanical & Mechanical (Manufacturing) Engineering Branches

SEMESTER III									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22ETBS301	BS-V	Mathematics –III	3	1	-	25	75	100	4
22ETES302	ES-III	Environmental Studies	3	-	-	25	75	100	3
22EIES303	ES-IV	Electric Machines and Drives	3	-	-	25	75	100	3
22EIPC304	PC-I	Electrical Circuit Analysis	3	-	-	25	75	100	3
22EIPC305	PC-II	Analog Electronic Circuits	3	-	-	25	75	100	3
22EIPC306	PC-III	Transducers and Measurement System	3	-	-	25	75	100	3
22EISP307	ESP-V	Fluid Mechanics and Hydraulic Machinery	2	-	2	40	60	100	3
22EICP308	PCP-I	Electric Circuits Lab	-	-	3	40	60	100	1.5
22EICP309	PCP-II	Analog Electronics Lab	-	-	3	40	60	100	1.5
			Total Credits						25

SEMESTER IV									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22ETBS401	BS-VI	Probability, Random Process and Numerical Methods	3	-	-	25	75	100	3
22ETES402	ES-V	Data Structures and Python Programming	2	-	-	25	75	100	2
22EIPC403	PC-IV	Analog Integrated Circuits	3	-	-	25	75	100	3
22EIPC404	PC-V	Digital Electronics	3	-	-	25	75	100	3
22EIPC405	PC-VI	Control Systems	3	-	-	25	75	100	3
22EIPC406	PC-VII	Electronic Instrumentation and Measurements Techniques	3	-	-	25	75	100	3
22ETHS407	HS-IV	Universal Human Values	2	1	-	25	75	100	3
22EICP408	PCP-III	Analog and Digital Integrated Circuits Lab	-	-	4 (2x2)	40	60	100	2
22EICP409	PCP-IV	Control Systems Lab	-	-	3	40	60	100	1.5
22EICP410	PCP-V	Transducers and Measurements Lab	-	-	3	40	60	100	1.5
			Total Credits						25
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
22EIPC501	PC-VIII	Microprocessor and Microcontroller	3	-	-	25	75	100	3
22EIPC502	PC-IX	Virtual Instrumentation and Smart Sensors	3	-	-	25	75	100	3
22EIPC503	PC-X	Process Control	3	-	-	25	75	100	3
22EIPC504	PC-XI	Industrial Instrumentation	3	-	-	25	75	100	3
22EIPE505	PE-I	Professional Elective I	3	-	-	25	75	100	3
22EIPE506	PE-II	Professional Elective II	3	-	-	25	75	100	3
22YYOE507	OE-I	Open Elective - I	3	-	-	25	75	100	3
22EICP508	PCP-VI	Measurement Data and Numerical Analysis Lab	-	-	3	40	60	100	1.5
22EICP509	PCP-VII	Microprocessor Lab	-	-	3	40	60	100	1.5
22EICP510	PCP-VIII	Process Control Lab	-	-	3	40	60	100	1.5
22ETIT511	IT-I	Industrial Training / Rural Internship/Innovation / Entrepreneurship	Four weeks during the summer vacation at the end of IV Semester				100	100	4.0
Total Credits									29.5

SEMESTER VI									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22EIPC601	PC-XII	Computer Networks and DCS	3	-	-	25	75	100	3
22EIPC602	PC-XIII	Instrumentation System Design	3	-	-	25	75	100	3
22EIPE603	PE-III	Professional Elective - III	3	-	-	25	75	100	3
22EIPE604	PE-IV	Professional Elective - IV	3	-	-	25	75	100	3
22EIPE605	PE-V	Professional Elective –V	3	-	-	25	75	100	3
22YYOE606	OE-II	Open Elective - II	3	-	-	25	75	100	3
22EICP607	PCP-IX	Instrumentation System Design lab	-	-	3	40	60	100	1.5
22EICP608	PCP-X	Embedded System and Internet of Things lab	-	-	3	40	60	100	1.5
						Total Credits			21
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									

SEMESTER VII									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22ETHS701	HS-V	Engineering Ethics	2	-	-	25	75	100	2
22EIPC702	PC-XIV	Computer Control of Processes	3	-	-	25	75	100	3
22EIPE703	PE-VI	Professional Elective-VI	3	-	-	25	75	100	3
22EIPE704	PE-VII	Professional Elective-VII	3	-	-	25	75	100	3
22YYOE705	OE-III	Open Elective - III	3	-	-	25	75	100	3
22EICP706	PCP-XI	Industrial Automation Lab	-	-	3	40	60	100	1.5
22ETIT707	IT-II	Industrial Training / Rural Internship/Innovation / Entrepreneurship	Four weeks during the summer vacation at the end of VI Semester				100	100	4.0
22EIPV708	PV-I	Project Work and Viva-Voce	-	-	S 2	-	-	-	-
Total Credits									19.5

SEMESTER VIII									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22YYOE801	OE-IV	Open Elective – IV	3	-	-	25	75	100	3
22YYOE802	OE-V	Open Elective – V	3	-	-	25	75	100	3
22EIPV803	PV-II	Project Work and Viva-Voce	-	PR 10	S 2	40	60	100	6
Total Credits									12

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

S.No.	COURSE CODE	LIST OF PROFESSIONAL ELECTIVES
1	22EIPESCN	Advanced Control Engineering
2	22EIPESCN	Digital System Design
3	22EIPESCN	Principles of Communication systems
4	22EIPESCN	Digital Signal Processing
5	22EIPESCN	Analytical Instrumentation
6	22EIPESCN	Embedded Systems and Internet of Things
7	22EIPESCN	Measurement Data Analysis
8	22EIPESCN	Instrumentation for Agriculture
9	22EIPESCN	Automotive Instrumentation
10	22EIPESCN	Instrumentation Symbols and Standards
11	22EIPESCN	Advances in PID Control
12	22EIPESCN	Calibration Systems
13	22EIPESCN	Microcontroller Based System Design
14	22EIPESCN	Soft Computing Techniques for Process Control
15	22EIPESCN	Power Plant Instrumentation
16	22EIPESCN	Introduction to Industry 4.0
17	22EIPESCN	Real Time Operating Systems
18	22EIPESCN	VLSI System Design
19	22EIPESCN	Unit Operations and Control
20	22EIPESCN	Non-linear Control Systems
21	22EIPESCN	Optimal Control
22	22EIPESCN	Fault Detection and Diagnosis
23	22EIPESCN	Building Automation
24	22EIPESCN	Multi sensor Data Fusion

S.No.	COURSE CODE	LIST OF OPEN ELECTIVES
1	22EIOESCN	Transducer Engineering
2	22EIOESCN	Test and Measuring Instruments
3	22EIOESCN	Industrial Measurements
4	22EIOESCN	Industrial Automation and Control
5	22EIOESCN	Electronic Design and Fabrication
6	22EIOESCN	Biomedical Instrumentation
7	22EIOESCN	Micro Electro Mechanical Systems
8	22EIOESCN	Nano Materials and Nano Electronics
9	22EIOESCN	Instrumentation and Control in Process Industries
10	22EIOESCN	Medical Imaging System
11	22EIOESCN	Diagnostics and Therapeutic Instruments
12	22EIOESCN	Artificial Intelligence in Industrial Automation
13	22EIOESCN	NCC Studies (Army Wing) - I
14	22EIOESCN	Intellectual Property Rights (IPR)
15	22EIOESCN	Industry 4.0
16	22EIOESCN	Machine Learning
17	22EIOESCN	Augmented & Virtual Reality (AR VR) Development
18	22EIOESCN	Block Chain
19	22EIOESCN	Cyber Security
20	22EIOESCN	Powering IOT using Raspberry Pi or Arduino
21	22EIOESCN	Machine Learning with Application to Object Recognition

S.No.	COURSE CODE	LIST OF HONOUR ELECTIVES	CREDITS
1	22EIHESCN	Model Predictive Control	4
2	22EIHESCN	Industrial Safety	3
3	22EIHESCN	Robotics & Automation	3
4	22EIHESCN	Fiber Optics and Laser Instrumentation	3
5	22EIHESCN	Process Data Analytics	4
6	22EIHESCN	SCADA Systems and Application	3

S.No.	COURSE CODE	LIST OF MINOR ENGINEERING ELECTIVES	CREDITS
1	22EIMISCN	Sensors and Transducers	3
2	22EIMISCN	Electronic Testing Instruments	3
3	22EIMISCN	Industrial Process Measurements	3
4	22EIMISCN	Essentials of Control Engineering	4
5	22EIMISCN	Fundamentals of Automation and Control	4
6	22EIMISCN	Principles of Medical Electronics	3

S.No.	COURSE CODE	LIST OF ONE CREDIT COURSES	CREDITS
1	22EIOCSCN	Matlab Programming	1
2	22EIOCSCN	Programming Using Linux	1
3	22EIOCSCN	PC Hardware	1
4	22EIOCSCN	Practical Approach of Problem Solving Techniques	1
5	22EIOCSCN	Basis of Labview	1
6	22EIOCSCN	Electronic System Design	1
7	22EIOCSCN	Programming with PLC and HMI	1
8	22EIOCSCN	Instrumentation System	1
9	22EIOCSCN	Sensors And Systems	1

S.No	COURSE CODE	LIST OF VALUE ADDED COURSES
1	22EIVAC01	Industrial Automation
2	22EIVAC02	Data Analysis, Visualization And Scientific Computation with Matlab
3	22EIVAC03	Arduino Programming to Build Real World Applications
4	22EIVAC04	Basics of Robotics

SEMESTER I

22ETBS101	MATHEMATICS -I	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To familiarize definite integrals and its application in finding area and volume.
- To introduce the fundamentals of functions of several variables.
- To make the student to learn infinite series and its nature.
- To impart knowledge about Vector calculus.
- To provide the concept of eigen values and eigen vectors of a real matrix and its properties of great utility in many branches of engineering.

UNIT I

INTEGRAL CALCULUS

Evaluation of definite integrals and their properties - Applications of definite integrals to evaluate surface areas and volumes of revolutions. Improper integral - Beta and Gamma functions and their properties.

UNIT II

FUNCTIONS OF SEVERAL VARIABLES

Rolle's theorem-Mean value theorem. Indeterminate forms - L'Hospital's rule, Functions of two variables: Taylor's and Maclaurin's series expansions - Maxima and minima for functions of two variables.

UNIT III

SEQUENCES AND SERIES

Convergence of sequence and series - Tests for convergence: Comparison test (only for series with positive terms) - D'Alembert's ratio test-Cauchy's root test-Integral test - Leibnitz's test (Alternating series).

UNIT IV

VECTOR CALCULUS (DIFFERENTIATION)

Gradient, divergence and curl - Directional derivative - Unit normal vector - Irrotational and solenoidal vectors - Expansion formulae for operators involving.

UNIT V

MATRICES

Rank of a matrix - Symmetric, skew - Symmetric and orthogonal matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley-Hamilton Theorem - Diagonalization of symmetric matrices by Orthogonal transformation.

TEXT BOOKS

1. Veerarajan T., "Engineering Mathematics for First Year", Tata McGraw-Hill, New Delhi, 2008.

2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 36th Edition, 2010

REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, 9th publishers, Reprint,2002.
2. Erwin kreyszig,“Advanced Engineering Mathematics”, 9th Edition, JohnWiley &Sons,2006.
3. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill New Delhi,11th Reprint, 2010.
4. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint,2008.

COURSE OUTCOMES

At the end of this course, Students will able to

1. Solve improper integrals using Beta and Gamma functions.
2. Evaluate the extreme values for functions of two variables.
3. Analyze the convergence of infinite series.
4. Understand vector differentiation and Recognize solenoidal and irrotational fields.
5. Solve eigen values and eigen vectors of a real matrix and Orthogonal transformation of a matrix.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									
CO2	3	3	2	2								
CO3	3	3	2									
CO4	3	3										
CO5	3	3	3	2	2							

22ETBS102	PHYSICS	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

To understand the ray of light to undergo the phenomenon of interference diffraction and polarization.
To understand the principle and various application of laser.
To develop knowledge in crystal structure and its properties.
To understand the energy quantization of subatomic particles like electron.
Rationalize the law of conservation of energy in solar water heater and solar cells.

UNIT I

WAVE OPTICS

Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer and Mach-Zehnder interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; diffraction gratings and their resolving power.

UNIT II

LASERS

Introduction - Principles of Laser - Stimulated emission, Properties of laser beams: mono- chromaticity, coherence, directionality and brightness Einstein's theory of, stimulated emission A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid - State lasers (ruby, Neodymium), dye lasers, laser speckles, applications of lasers in science, engineering and medicine.

UNIT III

CRYSTAL PHYSICS

Introduction to solid Materials - Crystal structure - Geometry of lattice unit cell - Bravais' lattice - Crystal systems, Crystal structures of Materials - (Cordination number, Atomic radius, packing factor and packing density) - Types of crystal Lattice (Simple Cubic, Body Centered Cubic, Face Centered Cubic and Hexagonal Closed Packed) Miller Indices and their calculations - Finding Miller indices of crystal planes.

UNIT IV

QUANTUM MECHANICS

Heisenberg uncertainty Principle - CDual nature of Matter and radiation - De Broglie's Wave length - Wave Velocity and group velocity. The wave Equation, Schrödinger's time dependent and independent wave equations - The Wave function and its physical significance - The particle in a box Problem (one dimensional box) - Energy quantization - Eigen values and Eigen functions.

UNIT V

ENERGY PHYSICS

Introduction to energy sources - Energy sources and their availability (Conventional and Non- conventional energy sources) solar energy - Methods of Harvesting solar energy - Solar heat collector, solar water heater and solar cells. Wind energy - Basic principle and components of wind energy Conversion system (WECS) - Application of wind energy. Biomass - Biogas Generation - Classification of Biogas plants - Properties and application of Biogas.

TEXT BOOKS

1. Arumugam.M. "Engineering Physics", Anuradha agencies, 2nd Edition, 1997.
2. John Twidell& Tony Weir, "Renewable Energy Resources", Taylor & Francis, 2005.
3. Avadhanulu. M.N. and Kshirsagar P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005
4. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publishers, New Delhi, 2003.
5. Rai.G.D, "Solar Energy Utilization" Volume-1 & 2 by - Khanna Publishers, New Delhi
6. Pajput. R. K. Non -Conventional energy sources and Utilization - S. Chand Publication -2013.

REFERENCE BOOKS

1. Rajendran.V , "Engineering Physics", Tata McGraw Hill publishers, 2009.
2. Rai G.D., "Non-conventional Energy sources", Khauna Publications, 1993.
3. Mani. P. "Engineering Physics", Dhanam Publication, Chennai, 2011.
4. Agarwal.M.P, "Solar Energy", S.Chand& Co., I Edn, New Delhi, 1983.

COURSE OUTCOMES

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

1. Gain knowledge on the construction of different types of interferometer.
2. Description on different types of laser and its application.
3. Analyze the importance of packing factor in different crystal system.
4. Evaluate the quantum mechanical concept of wave velocity and group velocity.
5. Compared the different energy resource and their availability.

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

22ETBS103	CHEMISTRY	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To understand water treatment techniques and basic knowledge on surface chemistry.
- To provide knowledge on electrochemical cells and chemistry involved in corrosion.
- To learn various processes involved in fuel refining and mechanism involved in energy storage devices.
- To develop knowledge about synthesis of various types of polymers and nano materials.
- To get basic knowledge on refractories, lubricants and spectroscopical techniques.

UNIT I

WATER CHEMISTRY AND SURFACE CHEMISTRY

Hardness of water - Softening of hard water by ion exchange method - Boiler feed water - Boiler troubles - Internal treatment methods - Estimation of hardness by EDTA method - Desalination of brackish water - Reverse Osmosis. Disinfection of water - Break point chlorination -Adsorption - Types of Adsorption - Freundlich and Langmuir adsorption isotherms - Applications of adsorption.

UNIT II

ELECTROCHEMISTRY AND CORROSION

Electrode potential - Electrochemical cell - Measurement of EMF - Nernst equation for cell EMF - Concentration cells - Electrochemical series - Conductometry - Conductance, Cell constant - Types of conductometric titrations. Potentiometry - Principle of acid base titration. Corrosion - Dry and wet corrosion - Galvanic, concentration cell and pitting corrosion - Control of corrosion by Cathodic protection method.

UNIT III

FUELS AND STORAGE DEVICES

Fuels - Classification - Calorific values - HCV and LCV - Analysis of coal - Proximate and ultimate analysis - Refining of petroleum. Cracking - Fixed bed - Synthetic petrol - Fischer -Tropsch process - Flue gas analysis by Orsat apparatus. Batteries - Primary and secondary - Dry cell - Lead acid storage battery - Ni-Cd battery - Lithium battery - H2-O2 fuel cell.

UNIT IV

POLYMERS AND NANO MATERIALS

Polymers -Types of polymerization - Addition, condensation and copolymerisation - Mechanism of addition polymerization (Free radical). Plastics - Thermoplastics and thermosetting plastics -Preparation, properties and uses of polyethylene, polyvinyl

chloride, polystyrene, Nylon and bakelite. Nano chemistry -Introduction to nano materials. Synthesis - Precipitation, sol- Gel process, electro deposition and chemical vapour deposition methods. Carbon nano tubes, fullerenes, nano wires and nano rods.

UNIT V

ENGINEERING MATERIALS AND SPECTROSCOPIC TECHNIQUES

Refractories - Classification, characteristics (Refractoriness, RUL, Thermal spalling, porosity) and uses, Lubricants - Classification, properties (cloud and pour point, flash and fire point, viscosity index) and applications. Principles of spectroscopy - Beer - Lambert's Law - UV -Visible and IR spectroscopy -Basic principles and instrumentation (block diagram) -Fluorescence and its applications in medicine.

TEXT BOOKS

1. Jain, P.C. and Monica Jain (2010) "Engineering Chemistry" DhanpatRai& Sons, New Delhi.
2. Dara, S.S. and Umare, S.S. (2014) "Text Book of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi.
3. Gopalan, R., Venkappaya, D. and Nagarajan, S. (2008) "Engineering Chemistry" Tata McGraw Publications Ltd., New Delhi.
4. Puri, B.R., Sharma, L.R. and Pathania, M.S. (2013) "Principles of Physical Chemistry" Vishal Publication Company, New Delhi.
5. Sharma, Y.R. (2010) "Elementary Organic Spectroscopy, Principle and Chemical Applications", S. Chand Publishers, New Delhi.
6. Asim K Das and Mahua Das (2017) "An Introduction to Nanomaterials and Nanoscience" CBS Publishers & Distributors Pvt. Ltd., New Delhi.

COURSE OUTCOMES

At the end of this course work, student will be able to

1. Develop innovative methods in soft water production for industrial uses and about adsorption analysis.
2. Describe the concept of electrochemistry and its applications; corrosion and its controlling methods.
3. Understand the properties of fuels and applications of energy storage devices.
4. Synthesis various polymers and understand about nanomaterials.
5. Gain knowledge on refractories, lubricants and understand the concepts of certain spectroscopical techniques

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

22ETES104	PROGRAMMING FOR PROBLEM SOLVING	L	T	P/D	C
		2	1	0	3

COURSE OBJECTIVES

- To understand the fundamentals of C programming
- To provide students with understanding of code organization and functional hierarchical decomposition using complex data types.
- To understand how to break a large problem into smaller parts, writing each part as a module or function
- To effectively utilize structures and pointers in problem solving
- To enable students to take up Systems programming or Advanced C programming course.

UNIT I

FUNDAMENTALS OF PROGRAMMING

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT II

EXPRESSIONS AND CONTROL STRUCTURES

Arithmetic Expressions and Precedence, Conditional Branching and Loops, Writing and evaluation of Conditionals and consequent Branching, Iteration and Loops.

UNIT III

ARRAYS

Arrays: Arrays (1-D, 2-D), Character arrays and Strings, Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

UNIT IV

FUNCTIONS

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT V

FILES AND STRUCTURES

Structure: Structures, Defining structures and Array of Structures, Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation). File handling (only if time is available, otherwise should be done as part of the lab).

TEXT BOOKS

1. Byron Gottfried, "Schaum's Outline of Programming with C",McGraw-Hill.
2. E. Balaguruswamy, "Programming in ANSI C", TataMcGraw-Hill.

REFERENCE BOOKS

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall ofIndia.

COURSE OUTCOMES

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

1. Formulate algorithms, draw flowcharts and write pseudocode for solving arithmetic and logical problems.
2. Develop C programs using branching and looping statements.
3. Implement searching and sorting algorithms and analyze the order of complexities.
4. Define and call simple functions by value and by reference and also to write recursive functions.
5. Utilize structures, pointers and files in C programming.

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

22ETHS105	HERITAGE OF TAMILS தமிழர் மரபு	L	T	P/D	C
		1	0	0	1

அலகு I: மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II: மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை V ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III: நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV: தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V: இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

1. Language and Literature: Language Families in India - Dravidian Languages - Tamil as a Classical Language - Classical Literature in Tamil -Secular Nature of Sangam Literature –Distributive Just icein Sangam Literature –Management Principles inThirukural –Tamil Epics andImpact of Buddhism&Jainismin TamilLand –Bakthi Literature Azhwars and Nayanmars.- Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.
2. Heritage - Rock art paintings to modern art - Sculpture: Hero stone to modern sculpture –Bronzeicons –Tribes and their handicrafts-Art of templecar making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.
3. Folk and Martial arts - Therukoothu, Karagattam, VilluPattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

4. Thinai concept of Tamils -Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.
5. Contribution of Tamils to Indian National Movement and Indian Culture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India -Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine -Inscriptions & Manuscripts -Print History of TamilBooks.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL -(in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of TamilStudies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of TamilStudies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of TamilStudies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, TamilNadu)
10. Studies in the History of India with Special Reference to TamilNadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by Department of Archaeology & TamilNadu Text Book and Educational Services Corporation, TamilNadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.

22ETHP106	COMMUNICATION SKILLS AND LANGUAGE LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To facilitate computer assisted multimedia instruction enabling individualized and independent language learning.
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- To bring about a consistent accent and intelligibility in student pronunciation of English by providing an opportunity for practice in speaking.
- To improve the fluency of students in spoken English
- To train students to use Language appropriately for public speaking, group discussion and interviews.

LIST OF TOPICS

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

Suggested Software Package: Globarena Package for communicative English The Globarena Package consists of the following exercises

1. Reading comprehension
2. Listening comprehension
3. Vocabulary exercises
4. Phonetics
5. Role Play in dialogues
6. Auto Speak

TEXT BOOKS

1. Daniel Jones Current," English Pronouncing Dictionary", Edition with CD.
2. R. K. Bansal and J. B. Harrison, "Spoken English ",Orient Longman 2006 Edn.
3. J. Sethi, Kamlesh Sadanand& D.V. Jindal, "A Practical course in English Pronunciation, (with two Audio cassettes)", Prentice-Hall of India Pvt. Ltd., New Delhi.
4. T.Balasubramanian," A text book of English Phonetics for Indian Students", (Macmillan).
5. "English Skills for Technical Students", WBSCTE with British Council, OL.

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Student will heighten their awareness of correct usage of English Grammar in writing and speaking.

2. Acquire speaking ability in English both in terms of fluency and comprehensibility.
3. Enhance competence in the four modes of literacy; Writing, Speaking, Reading and Listening.
4. Ensure student to improve their accuracy and fluency in producing and understanding spoken and written English
5. Exposure of the grammatical forms of English and the use of these forms in specific communicative contexts.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3								3		3
CO2		3								3		3
CO3			2							3		3
CO4		2								3		3
CO5			3							3		3

22ETSP107	ENGINEERING WORKSHOP PRACTICE	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To provide the students simple hands-on-experience in the basic aspects of production engineering in fitting, carpentry and sheet metal.
- To familiarize the students in the various hand forging operations

CARPENTRY: Use of hand tools - exercises in planning and making joints namely, Lap joint, Lenthhening joint, half lap joint, dovetail joint, mortising and tenoning etc.

FITTING: Use of bench tools, vice, hammers, chisels, files, hacksaw, centre punch, twist drill, taps and dies - Simple exercises in making T, V joint and dovetail joints.

SHEET METAL WORK: Use of hand tools - Simple exercises in making objects like cone, funnel, tray, cylinder.

SMITHY: Demonstration of hand forging and drop forging.

COURSE OUTCOMES

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

1. Use basic tools of fitting, carpentry and sheet metal fabrication.
2. Fabricate simple carpentry joints.
3. Develop skill to make simple fitting joints.
4. Create simple shapes of sheet material.
5. Distinguish hand forging and drop forging operation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2		2		3					3
CO2	3		2		2		3					3
CO3	3		2		2		3					3
CO4	3		2		2		3					3
CO5	3		2		2		3					3

22ETSP108	ELECTRICAL WIRING AND EARTHING PRACTICE LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To create an awareness on the electrical safety in industrial and commercial environment.
- To enable the understanding on the principles of different types of electrical wiring.
- To offer exposure on the need for earthing and earthing practices.
- To provide practical knowledge on the various types of lighting circuits.
- To introduce methods for measuring the variables in electric circuits.

LIST OF EXPERIMENTS

1. Residential Wiring
2. Fluorescent lamp wiring
3. Stair case Wiring
4. Godown Wiring
5. Ceiling fan wiring
6. Industrial Wiring
7. Series and Parallel Lamp Circuits
8. Measurement of Earth Resistance
9. Measurement of Parameters in a Single-Phase AC Circuit
10. Measurement of Voltage, Current, Power and Power factor in a Resistive Circuit
11. Soldering Practice -Components devices and circuits -using general purpose PCB
12. Corridor Wiring
13. Test the operation and control circuit for LED Flourescent Lamp (18W)
14. Study of various categories of Fuses and Insulators
15. Study and test the operation of Automatic Iron Box
16. Testing the buck/boost functions of the domestic stabilizer

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Familiarize with the electrical safety measures.
2. Identify the different types of electrical wiring.
3. Know the necessity of Earthing.
4. Gain knowledge on the different types of lighting circuits.
5. Understand the methods for measuring electrical variables.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			2			2					3
CO2	3			2			2		2			3
CO3	3			2			2		2			3
CO4	3			2			2		2			3
CO5	3			2			2		2			3

SEMESTER II

22ETHS201	ENGLISH	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To ensure the students with good vocabulary
- To make the students participate actively in writing activities
- To practice the unique qualities of professional writing style
- To develop the students the proficiency in communicative skills
- To ensure the students to face the demand of their profession

UNIT I

VOCABULARY BUILDING

The concept of Word Formation
Root words from foreign languages and their use in English
Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Count and uncount nouns.
Synonyms, antonyms, and standard abbreviations.
Language development - Wh questions asking and answering yes or no questions.

UNIT II

BASIC WRITING SKILLS

Sentence Structures
Use of phrases and clauses in sentences
Importance of proper punctuation
Creating coherence and Techniques for writing precisely
Organizing principles of paragraphs in writing

UNIT III

NATURE AND STYLE OF SENSIBLE WRITING

Describing and Defining
Classifying and Providing examples or evidence
Writing introduction and conclusion
Comprehension
Precise Writing

UNIT IV

WRITING PRACTICES & ORAL COMMUNICATION

Listening to lectures and making notes
Mechanics of presentation, asking and giving instruction
Essay Writing -Writing analytical essays and issue based essays
Dialogue writing and conversation
Letter writing -Formal and informal

UNIT V

GROUP DISCUSSION AND JOB APPLICATION

Characteristics and practices of group discussion
Job application
Resume preparation
Writing reports -minutes of a meeting, accident, survey E-mail -etiquette

TEXT /REFERENCE BOOKS

1. Michael Swan,"Practical English Usage", OUP, 1995.
2. F.T. Wood,"Remedial English Grammar",Macmillan,2007.
3. William Zinsser,"On Writing Well", Harper Resource Book, 2001,
4. Liz Hamp - Lyons and Ben Heasly,"Study Writing", Cambridge University Press, 2006.
5. Sanjay Kumar and PushpLata, "Communication Skills" Oxford University Press, 2011.
6. "Exercises in Spoken English. Parts. I-III", CIEFL, Hyderabad, Oxford University Press.
7. Raman, Meenakshi and Shama, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press, New Delhi,2014.

COURSE OUTCOMES

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

1. Comprehension, writing and speaking skills. Get an exposure of vocabulary and gain a good glossary.
2. Get knowledge regarding use of Grammar in speech and writing.
3. Acquire a knowledge of remembering, understanding, applying, analyzing, evaluating & creating.
4. Determine how to articulate their ideas effectively to a variety of listeners.
5. Acquire ability to speak and write effectively in English.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2		2						3		3
CO2		2		2						3		3
CO3			3							3		3
CO4			2	3						3		3
CO5			3	2						3		3

22ETBS202	MATHEMATICS -II	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To familiarize multiple integrals and its application in finding area and volume.
- To make the student to learn line, surface and volume integrals.
- To solve Second order linear differential equations with constant coefficients.
- To acquaint the student with the techniques in the theory of analytic functions.
- To introduce the fundamentals of complex integrations.

UNIT I
MULTIVARIABLE CALCULUS (INTEGRATION)

Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Applications: Area as a double integral. Triple integrals (Cartesian) - Applications: Volume as a triple integral.

UNIT II
VECTOR CALCULUS (INTEGRATION)

Line, Surface and Volume integrals - Gauss divergence theorem (without proof) - Green's theorem in the plane (without proof) -Stokes theorem (without proof).Verification of the above theorems and evaluation of integrals using them.

UNIT III
ORDINARY DIFFERENTIAL EQUATIONS

First order ordinary differential equations (Linear and Bernoulli's differential equations, exact differential equations). Solution of Second order ordinary linear differential equations with constant co-efficient (method of variation of parameters only).Solution of Second order ordinary linear differential equations with variable co-efficient (Euler and Legendre's linear equations).

UNIT IV
COMPLEX VARIABLE (DIFFERENTIATION)

Analytic functions and their properties - Cauchy-Riemann equations - Harmonic functions -harmonic conjugate of elementary analytic functions-Construction of an analytic function. Mobius transformations.

UNIT V
COMPLEX VARIABLE (INTEGRATION)

Cauchy theorem (without proof) - Cauchy Integral formula (without proof) - Cauchy Integral formula for higher derivatives (without proof) -zeros and poles of an analytic

functions -singularities. Residues - Cauchy Residue theorem (without proof) - Evaluation of definite integral using them. Taylor's series and Laurent's series.

TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36thEdition,2010.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley &Sons,2006.

REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson,Reprint,2002.
2. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn., Wiley India, 2009.
3. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India,1984.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., Mc- Graw Hill, 2004.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

COURSE OUTCOMES

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

1. Solve double and triple integrals in finding area and volumes.
2. Apply line, surface and volume integrals in Gauss, Greens and Stoke'stheorems.
3. Solve Second order linear differential equations with constant coefficients.
4. Construct analytic function and analyze conformal mappings.
5. Evaluate the complex integrals and contour integration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2								
CO2	3	3	2									
CO3	3	3	3	3	3							
CO4	3	3	2									
CO5	3	3	3	2								

22ETES203	BASIC ENGINEERING {Civil (2 Units), Civil (3 Units), Mechanical (2 Units), Electrical and Electronics (3 Units)}	L	T	P/D	C
		4	0	0	4

BASIC CIVIL ENGINEERING (2 Units)

COURSE OBJECTIVES

- To inculcate a knowledge on essentials of Civil Engineering and to expose on the role of significance and contributions
- To satisfying societal needs and illustrate the concepts of various construction techniques

UNIT I

Introduction to Civil Engineering - Various disciplines of Civil Engineering - Introduction to various building materials Stone, Bricks, Steel, Cement, Concrete – its characteristics, types and uses. Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances – chain – compass: Introduction to Leveling, Total station, Remote sensing.

UNIT II

Building construction – foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry – Header, Stretcher, Flemish and English Bond. Columns, Lintels, Roofs – functions, types, roofing materials. Bridges – necessity - selection of site – components of a bridge: Dams – types – selection site - forces acting on a dam – Roads – uses - classification of roads – components of a road.

TEXT BOOKS

1. Ramesh babu. V, A text book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
2. Palanichamy M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company ltd, 2000.

REFERENCE BOOKS

1. Ramamrutham V, Basic Civil Engineering, DhanpatRai Publishing Co. (P) Ltd., 1999.
2. Natarajan K V, Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
3. SatheeshGopi, Basic Civil Engineering, Pearson Publications, 2010.

COURSE OUTCOMES

1. Understand the basic knowledge on civil engineering materials
2. Develops the skill to satisfy the social needs and suitable method of construction technique

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2									2	3	2	2
CO2	3	2	2									2	2	3	2
CO3															
CO4															
CO5															

BASIC CIVIL ENGINEERING (3 Units)

COURSE OBJECTIVES

- To inculcate a knowledge on essentials of Civil Engineering
- To expose the students on the role, significance and contributions of Civil Engineering in satisfying societal needs
- To illustrate the concepts of various construction techniques

UNIT I

Introduction to Civil Engineering - Relevance of Civil Engineering in the overall infrastructural development of the country. Introduction to various building materials -Stone, Bricks, Steel, Cement, Concrete, Timber -its characteristics, types and uses. Various types of buildings as per NBC; Selection of suitable site for buildings, Components of a residential building -its functions, Orientation of a building, simple definitions - Plinth area / built up area, floor area / carpet area - floor space index.

UNIT II

Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances - Chain - Compass: Introduction to Leveling, Total station, Remote sensing - Fundamental principles and applications.
Building construction - Foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry - Header, Stretcher, Flemish and English Bond. Columns, Lintels, Roofs - Functions, types, roofing materials, Floors -functions, types, flooring materials. Decorative finishes - Plastering, interior design.

UNIT III

Bridges - Necessity - Selection of site - Components of a bridge: Dams -Types - Selection of site - Forces acting on a dam - Roads - Uses - Classification of roads - Components of a road; Railways - Basic components of permanent way -Water supply - Per capita requirement - Sources - Need for conservation of water - Rain water harvesting - Basic water treatment - Sewage and its disposal - Basic definitions - Septic tank - Components and functions.

TEXT BOOKS

1. Ramesh babu. V, A text book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
2. Palanichamy M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company ltd, 2000.

REFERENCE BOOKS

1. Ramamrutham V, Basic Civil Engineering, DhanpatRai Publishing Co. (P) Ltd., 1999.

2. Natarajan K V, Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
3. SatheeshGopi, Basic Civil Engineering, Pearson Publications, 2010.

COURSE OUTCOMES

1. Understand the basic knowledge on Civil engineering materials
2. Develops the skill to satisfy the social needs
3. Describe the suitable method of construction technique

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2									2	3	2	2
CO2	3	2	2									2	2	3	2
CO3	3	2	2			2						2	2	2	3
CO4															
CO5															

BASIC MECHANICAL ENGINEERING (2 Units)

COURSE OBJECTIVES

- To familiarize the students the functioning of boilers, turbines and internal combustion engines.
- To provide knowledge about the use of various machine tools and manufacturing processes

UNIT I

Energy Conversion Devices: Boilers - Classification - Description and working of Cochran boiler - Babcock and Wilcox boiler. Steam turbines: Principles and working of Impulse and Reaction turbines. Gas turbines: Principles and working of Open cycle and Closed cycle gas turbines. Internal Combustion Engines: Classification - Principal parts - Two stroke and four stroke cycle engines - Working principle of petrol and diesel engines - Concept of CRDI and MPFI fuel injection systems - Hybrid engines. Battery electric vehicles (BEV) - key components

UNIT II

Formative Manufacturing Processes: Forging - Principle and operations; Rolling - Principle, rolling mill configurations; Extrusion - Direct versus indirect extrusion. Metal Casting: Principle - Green sand moulding - Injection moulding. Subtractive Manufacturing: Description of parts and operations performed: Lathe, Shaper, Universal Drilling machine, Universal Milling Machine - CNC Machining Centers. Additive Manufacturing Processes: 3 D Printing: Classification - Steps - Advantages - Disadvantages - Stereo lithography process - Gas welding -principle, Oxy-acetylene welding - Equipment, Arc welding - Principle - Equipment - Brazing: Types - Soldering - Comparison of brazing and soldering.

TEXT BOOKS

1. Prabhu T J, Jaiganesh V and Jebaraj S, Basic Mechanical Engineering, Scitech Publications Pvt. Ltd., Chennai, 2016.
2. Venugopal and Prabhuraj T J, Basic Mechanical Engineering, ARS publishers, Sirkali, 1996.

REFERENCE BOOKS

1. Hajra Choudhury S. K., Nirjhar Roy, Hajra Choudhury A. K., Elements of Workshop Technology,(Vol 1 and Vol II,) , Media Promoters, Pvt Ltd. (2008)
2. Rao P. N., Manufacturing Technology : Foundry, Forming and Welding - Vol 1,Mc Graw Hill Education, (2013)
3. Steven R. Schmid, Serope Kalpakjian, Manufacturing Processes for Engineering Materials (English) 5th Edition, Pearson India, (2009)

COURSE OUTCOMES

At end of this course work, Students will be able to

1. Demonstrate the working of various energy conversion devices such as boilers, turbines and internal combustion engines
2. Appraise the fundamental concepts of manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (3 Units)

COURSE OBJECTIVES

- To understand the basics of Electrical circuit laws and fundamentals of AC circuits
- To understand the working of DC Machines, transformers and AC machines
- To learn the basics of electronic devices and Communication Systems

UNIT I

BASIC CIRCUITS

Definition of current and voltage - Electrical circuit elements (R, L and C) - Ohm's Law- Kirchhoff's laws - solution for currents and voltages - AC circuits - RMS -Average values - Introduction to 3 phase systems - Advantages

UNIT II

ELECTRICAL MACHINES

Laws of Electromagnetism - Construction of DC Machines - DC Generator - EMF Equation - DC Motor - Principle of operation - Types – Characteristics

Single-phase Transformer: Construction and Working principle - EMF equation - Three-phase transformer - Working principle.

Three-phase induction motor – Construction and working principle - Single-phase induction motor - Alternators - Working principle

UNIT III

BASIC ELECTRONICS

P-N junction - VI Characteristics of PN junction diode, Zener diode - Rectifier circuits- Voltage Regulator using Zener diode - Elements of Communication Systems - Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TEXTBOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
2. A K Theraja &B L Theraja, A Textbook of Electrical Technology, Vol.2, S. Chand Publishing, 2014.

REFERENCE BOOKS

1. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 1989.
2. V.K. Mehta, Rohit Mehta, "Basic Electrical Engineering", S.Chand Publications, 2012.

COURSE OUTCOMES

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

- Understand the concepts related with electrical circuits and AC fundamentals.
- Acquire knowledge on the concepts of DC machines, Transformers and AC machines
- Enhance the knowledge about the basic electronic devices and their applications.
  Gain insight on the various elements of Communication systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1									2			
CO2	3	2	1									2			
CO3	3	2	1									2			
CO4															
CO5															

22ETHS204	TAMILS AND TECHNOLOGY தமிழரும் தொழில்நுட்பமும்	L	T	P/D	C
		1	0	0	1

அலகு I: நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு– சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு III: உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV: வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V: அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் 3 தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் V தமிழ் மின் நூலகம் 3 இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

1. **Weaving and Ceramic Technology**:Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.
2. **Design and Construction Technology:**Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) -Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.
3. **Manufacturing Technology**:Art of Ship Building - Metallurgical studies - Iron industry-Iron smelting, steel - Copper and gold - Coinsassource of history - Minting of Coins - Beads making - Industries Stone beads - Glass beads - Terracotta beads - Shell beads/bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

4. **Agriculture and Irrigation Technology:**Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conchediving - Ancient Knowledge of Ocean - Knowledge Specific Society.
5. **Scientific Tamil & Tamil Computing**: Development of ScientificTamil - Tamil computing - Digitalization of Tamil Books - Development of Tamil Software - Tamil Virtual Academy -Tamil Digital Library - Online Tamil Dictionaries - Sorkuvai Project.

TEXT-CUM-REFERENCEBOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL -(in print)
6. Social Life of the Tamils The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).
7. Historical Heritage of theTamils (Dr.S.V.Subatamanian,Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of theTamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilizationon the bank so friver Vaigai'(Jointly Published by:Department of Archaeology&TamilNadu TextBook and Educational Service Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22ETBP205	PHYSICS LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To access the Rigidity modulus of wire.
- To assess the various properties of light.
- To assess the characterization of Metals.
- To analyses the thickness of microsized objects.

LIST OF EXPERIMENTS

1. Air Wedge
2. Newtons's Rings
3. Simple Pendulum
4. Dispersive power of the Prism
5. Diffraction Grating
6. Acoustic diffraction Grating
7. Compound Pendulum
8. Kunt's tube experiment
9. Young's double slit experiment
10. Laser Grating
11. Torsional Pendulum
12. Young's Modulus -Non-uniform Bending
13. Young's Modulus –Uniform Bending.

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Acquired the knowledge of torsional properties of metals wire
2. Determine the radius of curvature of the plano-convex lens.
3. Determine the dispersion power of the prism.
4. Evaluate the important characteristics of simple and compound pendulum
5. Determine the Young's Modulus of uniform and non-uniform bending.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3						2		2	3		3
CO2	3						2		2	3		3
CO3	3						2		2	3		3
CO4	3						2		2	3		3
CO5	3						2		2	3		3

22ETBP206	CHEMISTRY LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To list the water quality standards.
- To assess the composition of an alloy.
- To appreciate the practical significance of acidimetry, alkalimetry,permananganometry, conductometry and potentiometry.
- To analyse quantitatively the amount of a substance present in a given sample.

LIST OF EXPERIMENTS

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductance of solutions
7. Potentiometry - determination of redox potentials and emfs
8. Saponification/acid value of an oil
9. Determination of the partition coefficient of a substance between two immiscibleliquids
10. Adsorption of acetic acid by charcoal
11. Volumetric analysis

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Determine the physical properties like surface tension and viscosity.
2. Determine rate of reactions and soapnification of oil.
3. Calculate the quantity of adsorbate adsorbed by charcoal.
4. Determine the impurity from Pharmacheutical products and hardness of water.
5. Determine exact concentration of acid and bases present in the industrial wastes.

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

22ETSP207	COMPUTER PROGRAMMING LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To enable students to code, compile and test C programs.
- To enable students to design algorithms using appropriate programming constructs for problem solving.
- Identify tasks in which the numerical techniques learned are applicable and apply them to write programs.
- To enable students to segregate large problems into functions using modular programming concepts.
- To enable students to apply pointer and structures in programs effectively.

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures
Tutorial 12: File handling:
Lab 12: File operations

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Analyze program requirements and develop programs using conditional and looping statements.
2. Write programs for handling arrays and strings.

3. Create C programs with user defined functions and recursive function calls.
4. Utilize pointers and structures for dynamic memory allocation in C programming.
5. Develop C programs for handling files.

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

22ETSP208	ENGINEERING GRAPHICS	L	T	P/D	C
		2	0	3	3

TRADITIONAL ENGINEERING GRAPHICS

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Reading a Drawing; Sectional Views; Dimensioning, True Length, Angle.

COMPUTER GRAPHICS

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM). (Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

COURSE OBJECTIVES

- To develop the ability to produce simple engineering drawing and sketches based on current practice
- To develop the means for communication of ideas, thoughts and design of objects, related to engineering applications, to others though drawing
- To develop the skills to read manufacturing and construction drawings used in industry
- To develop a working knowledge of the layout of plant and equipment
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators

UNIT I

INTRODUCTION TO ENGINEERING DRAWING

Introduction to Engineering Drawing: Lettering, Dimensioning and use of drawing instruments. Conic sections: Eccentricity method of/for drawing ellipse, parabola and hyperbola- Tangent and Normal from a point on the curve.

UNIT II

ORTHOGRAPHIC PROJECTIONS

Orthographic projections: Introduction -Projections of points Projections of Straight lines: Determination of true length and true angle of inclinations using half cone and trapezoidal methods -drawing the projections of straight lines using half cone method from true length and true angle of inclinations.

UNIT III

PROJECTIONS OF REGULAR SOLIDS

Projections of solids in simple position: Projections of cube, Tetrahedron, prisms, Pyramids, cone and cylinder. Projections of solids: Auxiliary projections -projections of prisms, pyramids, cylinder and cone when the axis is inclined to only one plane.

UNIT IV

SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS,

Sections of solids: Sections of prisms, pyramids, cylinder and cones -true shape of section. Developments of solids: Developments of lateral surfaces of solids using parallel and radial line methods.

UNIT V

ISOMETRIC PROJECTIONS

Isometric projections: Projections of simple solids. Conversion of pictorial view of simple objects into orthographic projections (only elevation and plan)

OVERVIEW OF COMPUTER GRAPHICS COVERING

Introduction to CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars). The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

CUSTOMIZATION & CAD DRAWING

Consisting of setup of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines and other basic geometric entities.

ANNOTATIONS, LAYERING & OTHER FUNCTIONS

Applying dimensions to objects and annotations to drawings; Setting up and use of Layers, Printing document stop a per using the print command; orthographic projection techniques Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation;

TEXT/REFERENCE BOOKS

1. BhattN.D.,Panchal V.M.& Ingle P.R.,(2014), Engineering Drawing, Charotar Publishing House.
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
5. (Corresponding set of) CAD Software Theory and User Manuals.

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Utilize drawing instruments effectively and able to present engineering drawings and sketches.
2. Describe the concept of orthographic, isometric projections of points, lines and regular solids.
3. Visualize the images and drawings in engineering perspective.
4. Practice sectioning of bodies like machines and equipment's.
5. Develop their technical communication skills and promote life-long learning.

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

VISION AND MISSION OF THE DEPARTMENT

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 OUTCOMES (POs)

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

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **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.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PE01	Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficientsolutions to challenging problems in Electronics, Instrumentation, Control and allied disciplines.
PE02	Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
PE03	Interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country
PE04	Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
PE05	Exhibit Professional and Ethical code of conduct, communication skills, team work and lifelong learning to resolve societal issues

Programme Specific Outcomes (PSOs)

PSO1: Acquire Knowledge of mathematics and Engineering fundamentals to formulate, solve and analyze complex problems related to electrical, electronics and instrumentation systems.

PSO2: Acquire ability to understand, design, develop and control various real-time industrial processes by applying standard practices and strategies of industrial requirement.

PSO3: Ability to apply knowledge of Programmable Logic Controller(PLC), Supervisory Control and Data Acquisition (SCADA) and Distributed Control Systems (DCS) to meet the requirements of Industry 4.0.

B.E (EIE)-CONSISTENCY OF PEOs WITH MISSION OF THE DEPARTMENT

PEO Statements	Mission Statements			
	M1	M2	M3	M4
PE01: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Instrumentation, Control and allied disciplines.	3	3	2	2
PE02: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.	2	3	2	3
PE03: Interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country	3	3	3	3
PE04: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.	3	2	2	3
PE05: Exhibit Professional and Ethical code of conduct, communication skills, team work and lifelong learning to resolve societal issues	3	2	3	2

3-Strong Correlation 2-Moderate Correlation 1-Weak Correlation

B.E (EIE)-MAPPING OF PEOs WITH POs

Mapping PO with PEO															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PEO1	3											3	3		
PEO2	3	2	3		3	1	1						2		3
PEO3						3		3	2	3	1			3	3
PEO4	2	2		2		3					3		1	3	
PEO5	1		2			2	2	2			3	1			2

3-Strong Correlation 2-Moderate Correlation 1-Weak Correlation

THIRD SEMESTER

22ETBS301	MATHEMATICS - III	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- To understand the basic concepts of partial differential equations which is helpful in solving Real world problems.
- Introduce Fourier series which is very useful in the study of electrostatics, acoustics and computing.
- Introduce Boundary value problems which is helpful in investigation of the important features of electromagnetic theory.
- The study of Fourier transform is useful in solving problems in frequency response of a filter and signal analysis.
- Provide a study of Z-transform which can played important role in the development of communication engineering.

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, Tata McGraw Hill Pub., 2005.
2. Singaravelu A, "Engineering Mathematics", Meenakshi Publications, Chennai, 2004.

COURSE OUTCOMES

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

1. Acquire basic understanding of the most common partial differential equations
2. Understand Fourier series.
3. Ability to solve some boundary value problems.
4. Fourier transform and Z-transform analysis.
5. To know about the transform and Differential equation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1										2		
CO2	2	2	2										2		
CO3	3	2	2										3		
CO4	3	2	1		2								3		
CO5	3	2	2		3								3		

22ETES302	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

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

ECOSYSTEMS

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

BIODIVERSITY AND ITS CONSERVATION

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

ENVIRONMENTAL POLLUTION

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

HUMAN POPULATION AND THE ENVIRONMENT

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. Himalaya Pub. 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, Compliances and Standards, 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.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1					1						2		
CO2	2	2					3						2		
CO3	3	2	2				2						2		
CO4	3		2		2	2	2						3		
CO5	3		2			2	2						3		

22EIES303	ELECTRIC MACHINES AND DRIVES	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

1. To impart fundamental knowledge on different DC Machines.
2. To introduce the concept of special machines to motivate the students to solve complex problems related to machines.
3. To impart knowledge on electrical drives and their usage in speed control.

UNIT I
DC MACHINES AND TRANSFORMERS

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 - speed control of DC motors - Principle - types - general constructional features of single phase transformers - regulation, efficiency - Autotransformer and three phase transformer - types and applications.

UNIT II
INDUCTION MACHINES

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

UNIT III
SYNCHRONOUS MACHINES

Principle - types and general constructional features - synchronous generators - characteristics - EMF equation - regulation – Synchronous motors - V curve - starting methods. Applications of synchronous generators and synchronous motors

UNIT IV
ELECTRIC DRIVES

Types of electric drives - Characteristics of Electric Drives - Advantages of electric drives - speed torque characteristics of various types of loads and drive motors - Selection of power rating for drive motors based on thermal limits, overload capacity and load variation factors.

UNIT V
CONTROL OF ELECTRIC DRIVES

Open loop and closed loop speed control - DC motor transfer function - speed and current control loops - single, two and four quadrant operations - Reversible drives - Armature and field current reversal - Dynamic and regenerative braking.

TEXT BOOKS

1) I.J.Nagrath and D.P.Kothari, Electric Machines, Second Edition, Tata McGraw – Hill Publishing Company Limited, 1997.

2) S K Bhattacharya, Electrical Machines, Third Edition, Tata McGraw - Hill Publishing Company Limited, 2009.
3) Pillai, S.K., “A First course on Electric Drives”, Wiley Eastern Ltd, Bombay, 1988
4)Dubey, G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2004.

COURSE OUTCOMES

1. Ability to understand the dc machines and transformers.
2. Ability to understand basic concepts and working principle of induction machines
3. Ability to understand the basic concepts and working of synchronous machines.
4. Ability to understand characteristics of various electrical drives.
5. Ability to understand the usage of drives in control aspects.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				1								2		
CO2	2				2								2	2	
CO3	2		2		2								2	1	
CO4	2	2	2		2								2	1	
CO5	2	3	2		2								2	2	

22EIPC304	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To introduce basic concepts of electrical circuits and to analyze using KCL and KVL.
- To learn and apply network theorems for solving circuit problems and to analyze circuits with dependent sources.
- To introduce basic concepts of single phase and three phase AC circuits.
- To introduce the concept of transient analysis of first and second order linear circuits and understand the concept of poles and zeros of transfer function.
- To learn the concept of two-port network parameters.

UNIT I

DC CIRCUIT FUNDAMENTALS

Linear, Nonlinear, Unilateral, Bilateral, Active and Passive elements. Voltage and Current sources:- Ideal, Practical, Dependent and Independent. Series and Parallel connections of resistances - Y-Δ transformation, Voltage and Current division in series and parallel circuits - Kirchhoff's Laws - Node and Mesh Analysis.

UNIT II

NETWORK THEOREMS

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem. Analysis with dependent current and voltage sources.

UNIT III

SINUSOIDAL STEADY STATE ANALYSIS

Sinusoidal and other periodic waveforms: –Average and RMS value, Form factor. Phasor representation of A.C quantities, phasor diagrams, impedances and admittances– AC circuit analysis. Power in an AC circuit -series and parallel RC, RL, RLC. Three-phase circuits.

UNIT IV

TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER LINEAR CIRCUITS

Source free RC, RL, RLC Circuit responses. Analysis of electrical circuits using Laplace Transform for standard inputs - Step response of RC, RL, RLC series and parallel circuits. Transfer function representation. Poles and Zeros.

UNIT V

TWO PORT NETWORKS

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. A.Sudhakar and Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill Education; Fifth edition, 2017.
2. Stalin.A.Boctor,“Electric Circuit Analysis ",Prentice-Hall; 1992.

REFERENCES

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
2. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
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. M. E. Van Valkenburg, “Network Analysis”, Third Edition, Pearson Education India of India, 2015.

COURSE OUTCOMES

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

1. systematically obtain the equations that characterize the performance of an electric circuit and to solve them using node or mesh analysis.(Unit I)
2. reduce complex network into simplified network by applying the theorems and solve circuit problems.(Unit II)
3. perform sinusoidal steady-state Analysis of both single-phase as well as three-phase AC Circuits.(Unit III)
4. obtain the transient response of RC,RL and RLC Circuits and perform transfer function analysis. (Unit IV)
5. analyze the behavior of two port networks .(Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3		
CO2	2	3	3										2	1	
CO3	1	3	1	2									3	2	
CO4	2	3		2									2	2	
CO5	1	2	2	3									3	2	

22EIPC305	ANALOG ELECTRONIC CIRCUITS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study the qualitative and quantitative exposition of fundamental concepts of silicon and germanium semiconductor devices and applications of Diode.
- To understand the principle, operation and characteristics of special diodes, bipolar junction transistor and their applications.
- To study the characteristics of MOSFET and its applications.
- To learn the characteristics, operation and application of SCR and UJT.
- To understand the function of various types of Oscillators.

UNIT I

PN JUNCTIONS

Types of semiconductor, Intrinsic semiconductor, Extrinsic semiconductor-P-type and N-type, PN junction, Diode circuits P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, clamping and clipping circuits.

UNIT II

SPECIAL PURPOSE DIODES AND BJT CIRCUITS

Zener diodes, Reverse characteristics of zener diode, Equivalent circuit, LED, LCD, Photo diodes. BJT circuits Structure, Symbols, and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: Types of BJT configurations, Base modulation and early effects, Current gain of BJT in common base and common emitter configuration, Relation between current gain α and β, small-signal model, biasing circuits, Types of voltage regulation: Zener diode shunt regulator, Transistor series and shunt regulator.

UNIT III

MOSFET CIRCUITS

MOSFET structure, Types of MOSFET, working, MOSFET Symbol and I-V characteristics. MOSFET as a resistor, MOSFET as a switch. MOSFET as an amplifier: Advantages of N-channel MOSFET over P-channel, small-signal model and biasing circuits, small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

UNIT IV

CONTROLLED SWITCHES

Silicon Controlled Rectifier (SCR) types, biasing, operation, equivalent circuit, Turning ON and turning OFF Methods, V-I Characteristics, Application. Unijunction Transistor (UJT), construction, equivalent circuit, operation, VI-characteristics, application.

UNIT V

OSCILLATORS

Brief concept of Feedback Amplifier, The Barkhausen criteria, Comparison between amplifier and oscillator, Classification of Oscillators, RC oscillators-Phase shift oscillator, Wein Bridge Oscillator, Hartley and Colpitts oscillator, Quartz crystal, Multivibrator-Types, Schmit trigger.

TEXT BOOKS

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008.
3. R.S.Sedha, " A Text Book of Applied Electronics" S.Chand Publications, 2006.

REFERENCES

1. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
2. Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012.
3. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th edition, July 2008.
4.M.K. Achuthan and K.N. Bhat, "Fundamentals of Semiconductor Devices", Tata McGraw-Hill Publishing Company Limited, 2007.

COURSE OUTCOMES

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

1. Design and analyse various types of rectifiers, clipper and clamper circuits. (Unit I)
2. Understand the characteristics of transistors and its applications. (Unit II)
3. Understand the fundamental concepts of MOSFETs and their applications for analog electronics circuits. (Unit III)
4. Understand the function of SCR and UJT. (Unit IV)
5. Understand the design of Oscillator circuits. (Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2			2									2		
CO3	2	1		2									2	1	
CO4	2	2		1	2								2	1	
CO5	2	1		1	2								2		

22EIPC306	TRANSDUCERS AND MEASUREMENT SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

1. To learn about the science of measurement system and its properties.
2. To acquire knowledge about characteristics of measurement systems subjected to time invariant and time variant inputs .
3. To understand the principle and characteristics of resistive, capacitive and inductive transducers.
4. 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 - Calibration methods – Static calibration- 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 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 Thermistor- 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 permittivity type - signal conditioning circuit- Frequency response -capacitor microphone- Capacitive pressure sensor- Proximity sensor.

Variable inductance –– LVDT – RVDT -Variable reluctance transducers - EI pick up - Eddy current non contacting transducers- Synchros – Microsyn – Principle of operation, construction details.

UNIT V

OPTICAL AND CHEMICAL 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, Silicon Micro sensors-Bio Sensors- Chemical Sensors - Environmental Monitoring sensors (Water Quality & Air pollution).

Note:
Unit I to Unit V: QUALITATIVE ANALYSIS ONLY

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 Measurement 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

1. Select a measurement system to meet the requirements. (Unit I)
2. Knowledge about characteristics of system based on the type of input. (Unit II)
3. Choose among the various types of resistance transducers for particular application. (Unit III)
4. Choose among the various types of capacitive and inductive transducers depending on the principle, range, cost and commercial availability. (Unit IV)
5. Understand the recent trends in the development of transducers and the engineering involved in it. (Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2	2										2		
CO3	2	1	1										2	2	
CO4	2	1	1										2	2	
CO5	2	2											2	2	1

22EISP307	FLUID MECHANICS & HYDRAULICS MACHINERY	L	T	P	C
		2	-	2	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
- 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 theoretically and experimentally
- To study the characteristics of centrifugal pumps and reciprocating pumps theoretically and experimentally

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 Centre of Pressure – Buoyancy - Metacentre

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 - Venturi Meter, Orifice Meter and Pitot Tube.

UNIT III

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.

UNIT IV

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

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 - Maximum Speed of a Reciprocating Pump - Study of Air Vessels

TEXT BOOKS

1. P.N. Modi & Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi; 2015.
2. R.K. Bansal, "A Text Book Of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Madras; 2011.
3. Jagdish Al, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, 9th Edition, **N**ew Delhi; 2014.

REFERENCES

1. K.L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
2. V.P. Vandana, "Theory and Design of Hydraulic Machines Including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

LIST OF EXPERIMENTS

1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturi meter
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. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
7. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
8. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
9. Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
10. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
11. Study of Performance characteristics of Francis Turbine (Constant Head method)

COURSE OUTCOMES

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

1. Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2. Understand various dynamics of fluid flow.
3. Use fluid dynamics for study of flow through pipes.
4. Present hydraulic design for the construction of efficient hydraulic turbines and pumps.
5. Get through knowledge of different kinds of pumps.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2	2										2		
CO3	2		2			2							2	2	
CO4	2	2	2										2	2	
CO5	2	2	2			2							2	2	

22EICP308	ELECTRIC CIRCUITS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To study & verify the circuit theorems practically
- To understand the sinusoidal steady state and transient response of AC circuits practically.
- To know the method of measuring voltage, frequency and phase of an ac wave using CRO.
- To learn the circuit connections and testing points of the circuit by simulation and implementation.
- To understand the method of power measurement in ac circuits practically.

LIST OF EXPERIMENTS

1. Analysis of DC resistive circuits and verification of Kirchhoff's Laws.
2. Verification of Maximum power transfer theorem.
3. Verification of Thevenin's theorem.
4. Verification of Norton's Theorem.
5. Verification of Superposition Theorem.
6. Steady State sinusoidal response of RLC series circuit.
7. Analysis of DC resistive circuit using EWB software.
8. Experimental determination of time constant of series R-L, R-C and R-L-C electric circuits
9. Study of CRO and measurement of sinusoidal voltage, frequency and power factor.
10. Determination of two port network parameters.
11. Experimental determination of power in AC circuits.
12. Simulation of electrical circuits using suitable software like Matlab/Pspice/Electronic workbench.

COURSE OUTCOMES

Make the students understand

1. The significance of the theorem and the practical verification of theorems.
2. The sinusoidal steady state analysis of AC circuits.
3. The way of measuring voltage, frequency and phase of an ac wave using CRO.
4. The circuit connections and testing points of the circuit by simulation and implementation.
5. The method of power measurement in AC circuits.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2										2		
CO2	2												2	2	
CO3	2		2										2	1	
CO4	2	2	2										2	1	
CO5	2	2			2								2		

22EICP309	ANALOG ELECTRONICS LAB	L	T	P	C
		-	-	3	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 simulate the various circuits using Electronics work bench software.
- To analyse frequency response of circuit components practically
- To design various oscillator and multivibrator circuits

LIST OF EXPERIMENTS

1. Ampere-Volt (I-V) characteristics of P-N junction semiconductor diode and Zener Diode.
2. Design of half wave and full wave rectifier circuits
3. Input and output characteristics of BJT and determination of its h-Parameters.
4. I-V characteristics of Silicon Controlled Rectifier.
5. I-V characteristics of UJT
6. Frequency response of RC coupled amplifier.
7. Simulation of rectifier, clipping and clamper circuits using Electronic Work Bench (EWB) software.
8. Characteristics of MOSFET
9. Design of JFET, MOSFET as a switch
10. Design of RC phase shift oscillator.
11. Design of Colpitt's oscillator
12. Design of Multivibrator circuits.

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.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3	2	2	2	2									1	2	
CO4	2	2	1	1	2								1	1	
CO5	2	1	1	1									1	1	

22ETBS401	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

1. Introduce Probability theory which is helpful in investigating the important features of the random experiment.
2. To understand the basic concepts of random processes which are widely used in Electrical fields.
3. The aim of theory of sampling is to get as much information as possible of the population to the process of making scientific judgments in the face of uncertainty and variation.
4. To develop the skills of the students in finding numerical solution of Interpolation, differentiation and integration problems.
5. Provide the study of numerical solution of algebraic and transcendental equations, the 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 - stationary –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, NUMERICAL DIFFERENTIATION AND INTEGRATION

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 rules.

UNIT V

SOLUTION OF ALGEBRAIC, TRANSCENDENTAL AND ORDINARY DIFFERENTIAL EQUATIONS

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. 2006, New Delhi.
2. Venkataraman, M.K., Numerical methods in Science and Engineering, National Publishing Co., Chennai - 2003.

REFERENCE BOOKS

1. Lipschutz, S., and Schiller, J., Schaums, Outlines – Introduction to Probability and Statistics, McGraw Hill, New Delhi, 1998.
2. Veerarajan, T., Probability theory and Random Process, Tata McGraw Hill Co., Ltd., New Delhi, 2005
3. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., Numerical Methods, S.Chand& Co. Ltd., New Delhi, 2004.

COURSE OUTCOMES

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

1. Acquire skills in handling situations involving random experiments.
2. Familiarize the concept of random processes.
3. Understand the basic concepts of theory of sampling to any collection of individuals of their attributes can be numerically specified.
4. Ability to solve problems algebraic transcendental equations and numerical integration.
5. Able to obtain numerical solution of ordinary and partial differential equations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3	2	2											2	2	
CO4	2	1	2	2									2	1	
CO5	2	2	1	1									2	1	

22ETES402	DATA STRUCTURES AND PYTHON PROGRAMMING	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

1. To gain knowledge in open-source tool like Python programming
2. Able to create simple applications using Python packages and Python Programming

UNIT I

INTRODUCTION

Introduction to Python Programming – Python basic variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc.

UNIT II

PROGRAM FLOW CONTROL

Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.

UNIT III

COMPLEX DATA TYPES

Python string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions.

UNIT IV

FILE OPERATIONS

Python Reading files, Writing files in python, Understanding read functions, read( ), readline( ), readlines( ). Understanding write functions, write( ) and writelines ( ) Manipulating file pointer using seek Programming, using file operations. Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database, Exception Handling in Databases.

UNIT V

PROGRAM PACKAGES

Simple programs using the built-in functions of packages matplotlib, numpy, pandas etc. GUI Programming: Tkinter introduction, Tkinter and Python Programming, Tk Widgets, Tkinter examples. Python programming with IDE.

TEXT BOOKS

1. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education, 2016
2. Charles Dierbach, "Introduction to Computer Science using Python", Wiley, 2015
3. Jeeva Jose & P.SojanLal, "Introduction to Computing and Problem Solving with PYTHON", Khanna Publishers, New Delhi, 2016

REFERENCE BOOKS

1. Rupesh Nasre, Python Programming, As per AICTE model curriculum based upon outcome based education, Printed and published by All India Council for Technical Education (AICTE), New Delhi, ISBN : 978-81-959863-5-4 (e-book).
2. Downey, A. et al., "How to think like a Computer Scientist: Learning with Python", John Wiley, 2015.
3. John Zelle, "Python Programming: An Introduction to Computer Science", Second edition, Course Technology Cengage Learning Publications, 2013.
4. Michel Dawson, "Python Programming for Absolute Beginners", Third Edition, Course Technology Cengage Learning Publications, 2013.
5. David Beazley, Brian Jones., "Python Cookbook", Third Edition, Orelly Publication, 2013.

COURSE OUTCOMES

1. To understand the basics of python programming using nested and control statements.
2. To create applications using Python Programming.
3. To perform file operations to read and write data in files.
4. To write programs for general purpose I/O devices using MicroPython.
5. To understand various Python packages.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2											2		
CO3	2	2	1	2	2								2		
CO4	2	2	1	2	2								2		
CO5	2	2	2	2	2								2		

22EIPC403	ANALOG INTEGRATED CIRCUITS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the features of IC and basic operation of Operational Amplifier
- To understand the different applications of Operational Amplifier and their design
- To design ADC and DAC using Operational Amplifier
- To design first order and second order filter
- To design timer IC and understand basics of PLL,VCO and its applications

UNIT I

OPERATIONAL AMPLIFIER

Block diagram of an Operational Amplifier. - simplified internal circuit diagram of 741 - IC package types - pin identification - temperature ranges -equivalent circuit – Open loop gain, Input bias current and offset voltage, slew rate, CMRR. Characteristics of ideal and practical Operational Amplifier.

UNIT II

OPERATORS AND DETECTORS

Comparator -Inverting and non-inverting zero crossing detector – applications of voltage level detector: Schmitt trigger - window detector. Modes of operation - inverting, non-inverting, differential mode. D.C. and A.C. amplifiers - summing, scaling, averaging amplifiers - integrator, differentiator - instrumentation amplifier, Precision rectifiers - V/F and F/V converters. Optocoupler and isolation amplifier - V to I and I to V Converters.

UNIT III

CONVERTORS

Charge amplifier - log amplifier - multiplier - divider - square root circuit - sample-hold Circuit. Data Converters - D/A Converters - Implementing a DAC function - Use of ladder networks - Bipolar coded DACs - Resolution, settling time transient errors. Monotonic, tracking, single-slope, dual-slope, delta-pulse modulation successive approximation and simultaneous (flash) A/D Conversion techniques and comparison - Typical ICs for D/A, A/D Conversion. DAC 0800 and ADC 0804 pin diagram and applications.

UNIT IV

FILTERS

Active Filters: Butterworth filters - first-order low pass, second-order low pass, first-order high pass, second-order high pass - higher order filters. Band pass filter - band reject filter - all-pass filter. Introduction to switched capacitor filter. Oscillators: Phase-shift type, Wien bridge and quadrature oscillators.

UNIT V

TIMERS & PHASE LOCKED LOOPS

Astable, monostable. Triangular wave and sawtooth wave generators. VCO, Timer 555 and applications. Phase-Locked Loops (PLLs): Principle, building blocks and characteristics of a PLL - Applications: frequency multiplier, modulator, FSK demodulator, synchronizer, voltage regulators.

TEXT BOOKS

1. R.A. Gayakwad, Op-Amp and Linear Integrated Circuits, 4th Edition, Prentice Hall of India, 2004.
2. R.F. Coughlin and F.F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, Prentice-Hall of India, 6th edition ,2003

REFERENCE BOOKS

1. Roy Choudhury , Linear Integrated Circuits, New Age International(p)Ltd.,2011
2. P.Horowitz and W.Hill, The Art of Electronics, Second Edition, Foundation Books, 1997
3. B.Guptha,Linear Integrated Circuits,S.K.Kataria & Sons,2013

COURSE OUTCOMES

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

1. Understand the characteristics of Operational Amplifier. (Unit I)
2. Design and analyse various rectifier and amplifier circuits using Operational Amplifier (Unit II)
3. Understand the fundamental concepts of Filters . (Unit III)
4. Understand the function and types of ADC and DAC. (Unit IV)
5. Understand the design of applications for analog electronics circuits using opamp. (Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2											2	2	
CO3	2	2	2		3								2	3	
CO4	2	1		2	3								2	1	
CO5	2	2	2	1									2	2	

22EIPC404	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 code.

UNIT II

DIGITAL HARDWARE

Logic levels, Realization of logic gates, different logic families- (RTL, DTL, TTL, ECL and CMOS)-operations, Logic levels, voltages and currents, fan-in, fan-out, speed, power dissipation. Comparison of logic families, Interfacing between different families.

UNIT III

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.

UNIT IV

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 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, 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. Menka Yadav, Digital Electronics, As per AICTE model curriculum based upon outcome based education, Printed and published by All India Council for Technical Education (AICTE), New Delhi, ISBN : 978-81-959863-0-9 (e-book).
2. A.Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
3. R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.
4. M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
5. S.Salivahanan and S. Arivazhagan, Digital Circuits and Design, Fourth Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.
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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	2				2								2		
CO3	2	2	3	3	3								2	2	
CO4	2	2	2	2	3								2	3	
CO5	3	2	2	2	3								2	3	

22EIPC405	CONTROL SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To make the students acquire knowledge in the basics of control system and its Components and to familiarize various representations of systems.
- To introduce the formulation of linear models like Transfer function model.
- To make the students analyze the stability of linear systems in time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain specifications.
- To make the students understand and analyse systems using state space models.

UNIT I

INTRODUCTION TO CONTROL SYSTEMS

Open-Loop and Closed-loop systems: Generalized Block Diagram of a Feedback System: Block diagram algebra- Signal Flow Graph. Transfer function models of linear time-invariant systems - Mathematical models of Mechanical & Electrical systems.

UNIT II

TIME RESPONSE ANALYSIS

Time response_ Order of a system - Response of first order system unit step input_ Response of second order systems for unit step input- time domain specifications- Response of P,PI,PD and PID controllers – Types of feedback control system - steady state error and static error constants- Generalized error coefficient.

UNIT III

FREQUENCY RESPONSE ANALYSIS

Sinusoidal Transfer function - Frequency domain specifications - Relationship between time and frequency response – Construction of Bode plots – Determination of Phase Margin and Gain margin from Bode plots - Polar plots - Determination of Phase Margin and Gain margin from Polar plots – Gain Adjustment using polar plots.

UNIT IV

STABILITY ANALYSIS AND ROOT LOCUS

Concept of stability - Necessary conditions for Stability – Routh-Hurwitz stability Criterion. Root locus concept: Guidelines for sketching Root locus plots for continuous time systems.

Stability in frequency domain: Nyquist stability criterion-Relative stability using Nyquist criterion.

UNIT V

DESIGN OF FEEDBACK CONTROL SYSTEM

Introduction to design - Lag, lead and lag-lead configurations: - design of cascade compensators in the time domain -Root-locus method of compensator design. Compensator Design specifications in frequency domain - design of cascade compensators in the frequency domain – Bode plot technique of compensator design.

TEXT BOOKS

1. I.J. Nagarath and M.Gopal, Control Systems Engineering (Multi colour edition), Seventh Edition, New Age International (P) Ltd., Publishers, 2021.
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. M. Gopal, Digital Control and State Variable Methods, McGraw-Hill Education, Fourth edition, 2017.

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 and to acquire the skill in developing transfer function models. (UNIT-I)
2. Determine time responses and analyze the transient response of a system and infer the time domain specifications. (UNIT-II)
3. Construct Bode plot & polar plot and analyze the effect of noise, disturbance and parameter variation through frequency response. (UNIT-III)
4. To analyze the stability of a system, to construct and interpret the Root locus and analyze the stability of the system from frequency response specifications. (UNIT-IV)
5. Design and implement lag, lead, lag-lead compensators to meet the time and frequency domain specifications (UNIT-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				1								2		
CO2	2	2			2								2	2	
CO3	2	2	1		2								2	1	
CO4	2	2	1		1								2	1	
CO5	2	2	2	2	2								2	2	

22EIPC406	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, analysers.
- 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 - AC current measurements – analog multimeters. Component measuring instruments

Q-meter - vector impedance meter - Power meter.

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

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.

UNIT IV

RECORDERS AND DISPLAY DEVICES

Recorders - moving coil, potentiometric, event recorders - X-Y plotters - U.V. recorders - digital recording. LED, LCD – annunciators, numeric, alphanumeric, graphics.

UNIT V

INTERFERENCE EFFECTS

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

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. D.F.A.Edwards, Electronic measurement techniques, Elsevier, 2014.
4. George.C.Barney, Intelligent Instrumentation, Prentice Hall of India, 1998.

COURSE OUTCOMES

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	2	2											2		
CO3	3	2			2								2		
CO4	2	3			2								2	2	
CO5	2	3	2	2	1								2	3	

22ETHS407	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	1	-	3

COURSE OBJECTIVES

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature / existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature / existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I

COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1.1 Purpose and motivation for the course, recapitulation from Universal Human Values-I.

1.2 Self-Exploration–what is it? - Its content and process; Natural Acceptance and Experiential Validation- as the process for self-exploration.

1.3 Continuous Happiness and Prosperity- A look at basic Human Aspirations.

1.4 Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority.

1.5 Understanding happiness and Prosperity correctly-A critical appraisal of the current scenario.

1.6 Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II

UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

2.1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.

2.2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.

2.3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

2.4. Understanding the characteristics and activities of 'I' and harmony in ' I'.

2.5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

2.6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making materia goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease

UNIT III

UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

3.1 Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure. mutual happiness; Trust and Respect as the foundational values of relationship.

3.2 Understanding the meaning of Trust; Difference between intention and competence.

3.3 Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

3.4 Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

3.5 Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life example, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

1.1 Understanding the harmony in the Nature.

1.2 Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature.

1.3 Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

1.4 Holistic perception of harmony at all levels of existence.

1.5 Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V

IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

5.1 Natural acceptance of human values.

5.2 Definitiveness of Ethical Human Conduct.

5.3 Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

5.4 Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5.5 Case studies of typical holistic technologies, management models and production systems.

5.6 Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

5.7 Sum up. include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

TEXT / REFERENCES

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi,2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi,2004.
4. The Story of Stuff(Book).
5. The Story of My Experiments with Truth- by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. FSchumacher.
7. Slow is Beautiful - CecileAndrews
8. Economy of Permanence - JCKumarappa
9. Bharat Mein Angreji Raj -PanditSunderlal
10. Rediscovering India - byDharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K.Gandhi
12. India Wins Freedom - Maulana Abdul KalamAzad
13. Vivekananda - Romain Rolland(English)
14. Gandhi - Romain Rolland(English)

COURSE OUTCOMES

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

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature).
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. They would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					3	2									
CO2			2	2	2	2									
CO3			2												
CO4					2										
CO5				2	2										

22EICP408	ANALOG AND DIGITAL INTEGRATED CIRCUITS LAB	L	T	P	C
		-	-	4	2

COURSE OBJECTIVES:

1. Design of analog and digital IC based circuits for industrial applications
2. Testing of logic gates with their truth tables and other digital ICs.
3. Simplification of complex logic functions using reduction techniques.
4. Study of Electronic Work Bench Software to simulate various electronic circuits.
5. Identification of malfunctioning of circuits/components and to troubleshoot the same.

LIST OF EXPERIMENTS

LINEAR ICS

1. Design and Testing of Inverting, Non inverting amplifiers, Summer, Differential Amplifier and Comparator.
2. Design and Testing of Differentiator and Integrator.
3. Design and Testing of Waveform generation circuits using op-amp
4. Design and Testing of Instrumentation amplifier
5. Design and Testing of Active low-pass and High-pass filters using op-amp.
6. Design and Testing of Phase shift and Wein bridge oscillators using op-amp.
7. Design and Testing of Astable and monostable multivibrators using 555 Timer
8. Design and Testing of DC power supply using IC 7805.

DIGITAL ICS

9. Verification of logic gates using integrated circuits.
10. Simplification of logic expressions using Karnaugh map techniques.
11. Implementation of half adder and full adder circuits using logic gates.
12. Design and Realization of one bit, two bit magnitude comparators.
13. Design and verification of parity generator circuits.
14. Design and simulation of 3 bit synchronous counter using EWB software.
15. Implementation of Digital to Analog converter.
16. Verification of Multiplexer/Demultiplexer.

COURSE OUTCOME

At the end of the course the students will be

1. Able to design application circuits using IC 741
2. Able to design instrumentation amplifier for measuring physical variables and design of waveform generators using operational amplifier
3. Able to design oscillators, Multivibrators and filters using ICs.
4. Able to understand the logic gates using their truth tables which is very useful in the design of Integrated Circuits.
5. Able to understand various digital IC based circuits like comparator, parity generator, converters, multiplexers.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2										2		
CO2	2	2											2	2	
CO3	2	2	2										2	1	
CO4	2	2		2	2								2	1	
CO5	2	2		1									2	1	

22EICP409	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. (a) Simulation of a Sampled data control system.
   (b) Characteristics of Sample and Hold circuit.
7. Sensitivity analysis of open loop and closed loop systems using Process Control Simulator.
8. Stability characteristics of feedback systems using Process Control Simulator.
9. Time response analysis of a Second order type-0 and type-1 system using Process Control Simulator.
10. Determination of transfer function of the given unknown system from the time response.
11. Determination of dominant closed-loop pole for the given specification using Root locus and verification using MATLAB software.
12. Mathematical modelling of physical system using MATLAB software.

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.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2								2		
CO2	2	2			1								2	2	
CO3	2	1	2	2	2								2	1	
CO4	2	1	2	2	2								2	1	
CO5	2	2	2	2	2								2	2	

22EICP410	TRANSDUCERS AND MEASUREMENTS 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, speed, strain and displacement.
- 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. Characteristics and Transfer function of RTD and Thermocouple.
4. a) Displacement measurement using LVDT
   b) Simulation of signal conditioning circuit for LVDT.
5. Measurement of Torque using Reaction type sensor.
6. Measurement of Load using load cell.
7. Characteristics of Light sensor (a) LDR (b) Photodiode
8. Characteristics of Thermistor and its application in Temperature alarm
9. a) Simulation of Voltage to Current converter and its practical implementation.
   b) Simulation of Current to Voltage converter and its practical implementation.
10. Speed Measurement using DC Motor.
11. Measurement of strain using cantilever beam.
12. Temperature measurement using RTD and Lead wire compensation.
13. Temperature measurement using Thermocouple and linearization of Thermocouple.
14. Calibration of Pressure using Dead weight tester.

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 and measurement for process variables such as temperature, strain, speed and displacement.
5) Apply the MATLAB and EWB software packages for the design and verification of signal conditioning circuits.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2	2	
CO3	2		1	2									2	2	
CO4	2	2	1	2									2	2	
CO5	2	2	2	2									2	2	

22EIPC501	MICROPROCESSOR AND MICROCONTROLLER	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 Micro Computer, 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. Apply the programming knowledge for various applications. (Unit–V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3	2	2											2	2	
CO4	2	2											2	2	
CO5	2	2	2	2	2								2	2	

22EIPC502	VIRTUAL INSTRUMENTATION & SMART SENSORS	L	T	P	C
		3	-	-	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

Concept of Virtual Instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency – Multiplexing of analog inputs – Single- ended and differential inputs – Different strategies for sampling of multi channel analog inputs. Concept of universal DAQ card – Use of timer- counter and analog outputs on the universal DAQ card.

Interfacing of external instruments to a PC – RS 232C, RS – 422, RS 485 and USB standards – IEEE 488 standard-Ethernet - 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.

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. Jovitha Jerome, Virtual Instrumentation using LabVIEW, Eastern Economy edition, PHI learning private Ltd., 2010.
2. Gary Johnson, LabVIEW Graphical Programming, McGraw Hill, 2006.
3. 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. 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3	2									2		
CO2	2		2	3										2	3
CO3	2	1	2	1	2								2	1	
CO4	2	3	3	2	3									2	2
CO5	3	2	2	2	3									3	3

22EIPC503	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 study about various instrumentation symbols used in industries.
- To introduce the concept of various complex control schemes.

UNIT I

MATHEMATICAL MODELLING OF PROCESSES

Introduction to process control, process variables, degree of freedom, Process modelling, characteristics of liquid systems, gas systems, thermal systems, mathematical model of first order level, pressure and thermal process, higher order process, interacting non-interacting systems. 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 positioners, I/P and P/I converters.

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. 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 McGraw Hill, 2012.
4. K.Krishnasamy and M.PonniBala, Power Plant Instrumentation, PHI, 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2		3								2		
CO2	2		2		2								2	2	
CO3	2	2	2	1	3								2	2	
CO4	2	2		2	2								2	2	
CO5	2			2	1								2	2	

22EIPC504	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3		1								3	1	
CO2	3	2	3		1								3	2	
CO3	3	2	3		1								3	2	
CO4	3	2	3		1								3	2	
CO5	3	2	3		1								3	2	

22EICP508	MEASUREMENT DATA AND NUMERICAL ANALYSIS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

1. To impart the fundamental knowledge on using various simulation tools for measurement data and numerical analysis.
2. To understand fundamental techniques of measurement and data analysis and report presentation.
3. To understand the importance of numerical solution in situation where analytical solution development is complex.

LIST OF EXPERIMENTS

1. Data Visualization
2. Matrix solutions to systems of Linear/Non-Linear Equation
3. (a) Finding roots of polynomials
   (b) Curve Fitting
4. Interpolation and Extrapolation
5. Regression Analysis
6. Least Squares Estimation
7. Variance of a vector - Covariance of a matrix- Correlation coefficient function
8. Solution of Ordinary Differential Equations (ODEs)
9. Solution of State space equations
10. Statistical measures related to random variable and distribution
11. Test of Hypothesis- F-test and Chi-Square test
12. Analysis of variance ANOVA

COURSE OUTCOMES

The student will be able to

1. To understand the fundamental techniques of measurement and data analysis and to report the results of an experiment.
2. To expose on methods for analyzing measurement data that are performed in industry and experimental research.
3. To understand usage of simulation tools required for data analysis.
4. To understand the importance of numerical methods in developing solutions.
5. To develop programs for measurement data and numerical analysis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	2	2			2								2		
CO3	2			2	2								2		
CO4	2	2	3	3	2								2	2	
CO5	2	3	3	2	2								2	2	

22EICP509	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. (a) Multiplication by repeated addition and subtraction.
   (b) Multibyte Decimal addition and subtraction.
2. (a) Finding Smallest/Largest number from an Array of 'n' numbers.
   (b) Sorting an array of numbers in Ascending/Descending order.
3. (a) Block movement of data.
   (b) Code conversion.
4. Interrupt using RST 5.5.
5. Switches and LED Interface.
6. ADC and DAC Interface with microprocessor.
7. 8253 Timer Interface.
8. 8259 programmable Interrupt controller.
9. Kit to Kit data transfer using USART 8251.
10. Stepper motor Interface.
11. Arithmetic Exercises in 8051 microcontroller using RAID IDE
12. Interfacing Push button and Buzzer with 8051 Microcontroller.

COURSE OUTCOMES

Understand the architecture of 8085.

1. Familiarize the architecture and instruction set of 8085 Microprocessor.
2. Design and interface I/O circuits.
3. Understand and apply the fundamentals of assembly level programming of microprocessors.
4. Implement the programming concepts to interface the hardware units with microprocessors.
5. Implement the programming knowledge for various real time applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											1		
CO2	3	2	3		2									2	
CO3	3	2	3										2	2	2
CO4	3	2	3		2								2	2	2
CO5	2	1	3		3								3	3	2

22EICP510	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.
2. Study of Control Valve characteristics.
3. Controller tuning using Process Reaction Curve method.
4. Study of Flow Control System and Determination of Transfer Characteristics of I/P
   Converter, Control Valve and Flow Transmitter
5. Determination of characteristics of a PID controller using Matlab (Simulink) software.
6. Design and simulation of Cascade control system using Matlab (Simulink) software.
7. Determination of Transfer function (Experimental model) of Level process.
8. Controller tuning using Continuous Cycling method.
9. Control of Air flow Process.
10. Design and Implementation of P and PI controller for an Air temperature control system.
11. Study of Programmable Logic Controller and its applications.
12. Determination of characteristics of Capacitive Level transmitter

COURSE OUTCOMES

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

1. To study piping and instrumentation drawing (P&I D) and characteristics of control valve & different processes.
2. To design and implementation of controller tuning techniques for various processes
3. To design and implement advanced control techniques.
4. Familiarize with TUTSIM and MATLAB software for process control applications.
5. Familiarize with PLC software and its applications for process control operations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1				1								1		
CO2	3	3	2	2	2								3	2	
CO3	3	3	3	2	3								3	2	
CO4	2	2			1								2		
CO5	3	2	2		2								3	2	3

22ETIT511	INDUSTRIAL TRAINING / RURAL INTERNSHIP / INNOVATION / ENTREPRENEURSHIP	L	T	P	C
		-	-	-	4

COURSE OBJECTIVES

- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related to Electronics and Instrumentation Engineering and to have a practical knowledge in carrying out field related works.
- To train and develop skills in solving problems during execution of certain works related to Electronics and Instrumentation Engineering.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Electronics and Instrumentation Engineering during the vacation for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the semester. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

COURSE OUTCOMES

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

1. Face the audience and to interact with the audience with confidence.
2. Tackle any problem during group discussion in the corporate interviews
3. Face the challenges in the field with confidence.
4. Manage the situation that arises during the execution of works related to Electronics and Instrumentation Engineering.
5. Develop the ability of writing technical papers for Conferences and Journals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2							2	2	2			2		
CO2	2		2					1	1				2	2	
CO3	2		3	2									2		2
CO4	3		3	2	2			2	2				3		2
CO5	3		2					3	2				3		3

22EIPC601	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/IP, Bridges - 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, Van Nostrand 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. Lawerence M.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 III)
4. Understand about profibus for data communication. (Unit IV)
5. Use HART and Filed Bus protocols for process industries. (Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2				2								2		
CO3	2	2	2	2	2								2	2	
CO4	2	1	2	2	2								2	2	
CO5	2	2		2	2								2	2	

22EIPC602	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

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
DESIGN OF FLOW AND TEMPERATURE SENSORS

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
ELECTRONIC PID CONTROLLERS

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

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
ALARM AND ANNUNCIATOR

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2		2								2	1	
CO2	2	2	2	2	2								2	1	
CO3	2	3	3	2	3								2	3	
CO4	2	2	2		2								2	3	
CO5	2	2	2	2	3								2	2	

22EICP607	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 using Electronic Work Bench (EWB) software.
9. Design of Alarm circuit using Logic gates.
10. Design of Signal conditioning circuit for the given process.
11. Design of control valve sizing.
12. 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 process control components

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1									3	3	
CO2	3	2	2	1	3								3	3	
CO3	3	2	2	1	1								3	3	
CO4	3	3	2	1	1								3	2	
CO5	3	3	2	1	3								3	2	

22EICP608	EMBEDDED SYSTEMS AND INTERNET OF THINGS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To understand the basic concepts of embedded system
- To become familiar with the architecture of Arduino and Raspberry pi.
- To develop skill in interfacing of Sensors and actuators using Ardunio IDE
- To familiarize the IoT Protocols and cloud platforms.
- To design and develop Android App for Smart Home Automation.

LIST OF EXPERIMENTS

1. Introduction to python programming using variables, strings and data operators
2. Examples for python programming using for loop, while loop and if statement
3. Python programming using functions and strings.
4. Interfacing input output module.
5. Monitoring patient body temperature using Raspberry pi.
6. Brightness control using PWM generation using Raspberry pi .
7. Detection of motion artifact using using Arduino development board.
8. Design of Traffic Light Control using Arduino development board
9. Interfacing sensors (infrared/ light/ temperature) using Arduino IDE
10. Development of simple application for home automation by using the cloud platform.
11. Monitoring and control of Room temperature using cloud platform
12. Measuring the distance using ultrasonic sensor using Cloud IoT platform

COURSE OUTCOMES

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

1. Understand the architecture of Arduino and Raspberry pi.
2. Familiarize with the programming of Arduino and Raspberry pi microcontrollers,
3. Understanding the interfacing concepts using Arduino IDE
4. Able to design and develop industrial automation applications which can interact with Sensors and Actuators.
5. Develop IOT applications with different platforms and frameworks.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2		2		2								2	3	
CO3	2	2	2										2		
CO4	2	3	3	2	2								2	3	2
CO5	2	3	3	3	2								2	3	2

22ETHS701	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”, Oxford University Press, 2001.
4. David Ermann and Michele S. Shauf, “Computers, Ethics and Society”, Oxford University Press, (2003).

COURSE OUTCOMES

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

1. Understand and build the relationship between the engineer and the society.
2. Describe the importance of Developing ethical codes in engineering practice.
3. Develop the knowledge on the legal, moral and ethical aspects in engineering.
4. Construct the moral and ethical dimensions in engineering.
5. Improve the Knowledge about Multinational Corporation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					3	3	3					1		
CO2	3					3	2	3					2		
CO3	3			2		3	2	3					1		
CO4	3					3	1	3					1		
CO5	3					3	1	3					1		

22EIPC702	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 andin 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											3		
CO2	2	2	2	3									2	2	2
CO3		3	3	2									2	3	
CO4				2									3	2	2
CO5	3	3	3	3	3								3	2	3

22EICP706	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 develop control strategies with programmable logic controller.
- To study data acquisition system using LABVIEW software.

LIST OF EXPERIMENTS

1. Design and simulation of Dead - Beat and Dahlin's controller for a higher order process using TUTSIM software.
2. Design and implementation of PI controller for a MIMO process.
3. Design and simulation of Dead-time compensator and Inverse response compensator with smith predictor algorithm using MATLAB/SIMULINK software.
4. Control of Air flow process using Programmable Logic Controller (Rock Well).
5. Control of bottle filling process using Programmable Logic Controller (GFANUC).
6. PC based control of a Pressure process.
7. Development of process mimic for a mixing tank using Intouch Wonderware software.
8. PLC based split range control of a level process.
9. Design and simulation of feed forward and feedback controller for a given process using MATLAB / SIMULINK software.
10. Design and implementation of controller for a non – linear process.
11. Design and implementation of controller for a pH process.
12. Development of control strategy for a level process in centum CS 3000 distributed control system.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1									2		
CO2	2		2	2									2	2	2
CO3	2		3	1	2								2	3	2
CO4	2	3		2	3								2	2	3
CO5	2	2			2								2		2

22ETIT707	INDUSTRIAL TRAINING / RURAL INTERNSHIP / INNOVATION / ENTREPRENEURSHIP	L	T	P	C
		-	-	-	4

COURSE OBJECTIVES

- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related to Electronics and Instrumentation Engineering and to have a practical knowledge in carrying out field related works.
- To train and develop skills in solving problems during execution of certain works related to Electronics and Instrumentation Engineering.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Electronics and Instrumentation Engineering during the vacation for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the semester. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

COURSE OUTCOMES

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

.1 Face the audience and to interact with the audience with confidence.
.2 Tackle any problem during group discussion in the corporate interviews
.3 Face the challenges in the field with confidence.
.4 Manage the situation that arises during the execution of works related to Electronics and Instrumentation Engineering.
.5 Develop the ability of writing technical papers for Conferences and Journals.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2							2	2	2			2		
CO2	2		2					1	1				2	2	
CO3	2		3	2									2		2
CO4	3		3	2	2			2	2				3		2
CO5	3		2					3	2				3		3

22EIPV803	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.
2. The student in a group prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.
3. 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.
4. A project report is required to be submitted at the end of the semester.
5. 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

On Completion of the project work students will be in a position

1. To Understand the modelling, analysis, design and control aspects.
2. To take up any challenging practical problems and find solution by formulating proper methodology
3. To Carrying out any experimental works on chosen topics.
4. To develop group behavior and leadership quality.
5. To develop communication skill, ethics and inter disciplinary knowledge.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										3		
CO2	3	2	3	2	2								3	2	
CO3	3	3	2	2	2								3	2	
CO4	3					2		2	3				3		
CO5	3					2		3		3			3		

PE - PROFESSIONAL ELECTIVES

22EIPESCN	ADVANCED CONTROL ENGINEERING	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To make the students acquire knowledge in the basics of sampled data control system and its stability analysis
- To introduce the formulation of state space models and its various representations for A MIMO system.
- To make students the analysis and time response of state space models
- To make the students acquire knowledge about Non linear system and its special behaviour.
- To make the students analyze the stability of Nonlinear systems.

UNIT I
SAMPLED DATA SYSTEM

Sampled data theory – Sampling process – Sample and hold circuits – Signal reconstruction –Pulse transfer function-Response of Sampled data system to step and Ramp inputs- Stability analysis of sampled data systems

UNIT II
STATE SPACE MODEL

Introduction to generalized state model – state diagram - state variable analysis for physical variable – mechanical and electrical systems – state model for armature and field controlled dc motor - phase variable and canonical variables model for continuous time systems – state model to transfer function.

UNIT III
STATE VARIABLE ANALYSIS

Decomposition techniques – Direct, cascade and parallel forms - Solution of homogeneous state equations – state transition matrix – Laplace transformation and Cayley Hamiltan methods - Eigen values and eigen vector - Controllability and Observability.

UNIT IV
NON LINEAR SYSTEM ANALYSIS

Types of non-linearity – Phase plane analysis – Singular points – Limit cycle – jump resonance - construction of phase trajectories – analytical method and isoclines method – Describing function analysis – Saturation, Dead zone, saturation-dead zone, Relay and Backlash.

UNIT V
STABILITY ANALYSIS

Definiteness of scalar functions –quadratic forms – Basics of stability theorems – Lyapunov functions – Direct method Lyapunov – constructing of Lyapunov functions using kravskii‟s method.

TEXT BOOKS

1. I.J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New Age International (P) Ltd., Publishers, 2009.
2. M. Gopal, Digital Control and State Variable Methods, McGraw-Hill Education, Fourth edition, 2017.
3. 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.

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 sampled data control system and its stability analysis. (Unit I)
2. Understand the concept of state variables and to assess the systems using various state space models. (Unit II)
3. Determine time responses of state space equations and analyze the controllability and Observability concepts. (Unit III)
4. Understand the concept of nonlinear systems and constructing the phase trajectories using various methods. (Unit IV)
5. Understand the concept of various stability methods of nonlinear systems. (Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2							1	3	1	
CO2	3	1	1	1	2							1	3	2	
CO3	3	3	2	3	2								3	1	
CO4	3	2	1	2	2								3	2	
CO5	3	3	2	3	2							1	3	2	

22EIPESCN	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).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2	1								3	3	
CO2	3	1	3	2	3							1	3	3	
CO3	3	1	3	3	3							1	3	3	
CO4	3	1	3	3	3							1	3	3	
CO5	3	1	3	3	3							1	3	3	

22EIPESCN	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, Pre emphasis 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, TataMcGraw 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, Oxford University 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).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		1	2								1	1	
CO2	3	1		2	1								2	1	
CO3	3	2		2	1								2	1	
CO4	3	1		2	1								2	1	
CO5	2	1		2	2								2	1	

22EIPESCN	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

Basic components of digital signal processing system – Advantages of digital signal processing over analog signal processing - Representation of standard discrete time signals – Basic operations on sequences – Convolution sum – Classification of signals - Discrete time systems – Classification – Representation of discrete time system 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
FREQUENCY DOMAIN ANALYSIS

Discrete Fourier Transform (DFT) - Properties of DFT - Magnitude and Phase representation - Computation of circular Convolution through DFT - Fast Fourier Transform Algorithm – DIT and DIF using radix 2 FFT – Butterfly structure.

UNIT IV
DESIGN OF IIR DIGITAL FILTER

Definition of digital filter –Properties of IIR digital filter - Design of IIR filter using Impulse Invariant method – Bilinear transformation method – Butterworth and Chebyshev approximations of low pass digital filter – Realization of IIR digital filters - Effect of finite register length and Quantization noise in IIR digital filter.

UNIT V
DESIGN OF FIR DIGITAL FILTER

Definition of FIR filter – Design of FIR filter using Fourier series method – Design using window functions –Rectangular window - Hamming window – Hanning window

– Kaiser window – Design of linear phase FIR digital filter using frequency sampling method.

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.
2. Analyze discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design and Realize IIR digital filters for various applications.
5. Design FIR digital filters for various applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3		
CO2	3	2	1	1	1								3	2	
CO3	3	3	2	2	3								3	2	
CO4	3	3	3	2	3								3	3	
CO5	3	3	3	2	3								3	3	

22EIPESCN	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To make the students understand basic theory and importance of instrumental analysis.
- To motivate the student to 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

INTRODUCTION

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 SPECTROSCOPY

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

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 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

Electrochemical methods - electrical conductivity of liquids – sulphur-di-oxidemonitor – 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 – Saunders College Publishers, Harcourt Brace College 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 spectroscopies. (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).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1								3		
CO2	3	1	1	2	1								2		
CO3	3	1	1	2	1								2		
CO4	3	2	1	2	1								2		
CO5	3	1	1	2	1								2		

22EIPESCN	EMBEDDED SYSTEM AND INTERNET OF THINGS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To Understand the concepts of embedded system design and analysis
- To understand Smart Objects and loT Architectures
- To learn about various IOT-related protocols
- To build simple loT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of loT

UNIT I

INTRODUCTION TO EMBEDDED SYSTEM DESIGN

Definition and Classification – Overview of Processors and hardware units in an embedded system - processor selection for an embedded system- memory selection- Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques - Designing with computing platforms – consumer electronics architecture – platform-level performance analysis.

UNIT II

ARDUINO AND RASPBERRY PI

The Arduino and ESP8266 Open-Microcontroller Platform - Arduino Basics - Arduino Board Layout & Architecture - Arduino family of boards with Pin description – Installation and Programming in Arduino IDE – Basic Commands for Arduino – Interfacing with sensors and Actuators - Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python.

UNIT III

FUNDAMENTALS OF IOT

Evolution of Internet of Things - The Internet of Things concept - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology. Functional blocks of a loT & IIOT ecosystem.

UNIT IV

IOT PROTOCOLS

Introduction to Cloud Computing - Characteristics of Cloud Computing - Cloud Computing - Cloud Deployment Model, loT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4 and LoRaWAN - Network Layer: IP versions, Constrained Nodes and Constrained Networks Routing over Low Power and Lossy Networks, Application Layer Protocols: CoAP and MQTT.

UNIT V

INDUSTRIAL APPLICATIONS

Smart Home - Wearables – Connected Cars – Industrial IoT Applications – IoT in Agriculture – IoT Applications in Retail – Energy Engagement – IoT in Healthcare, Smart and Connected Cities: Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TEXT BOOKS

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete. Rob Barton and Jerome Henry, "loT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
3. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015

REFERENCE BOOKS

1. Olivier Hersent, David Boswarthick, Omar Elloumi, ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012.
2. Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
4. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance your projects, 2nd Edition, O'Reilly_Media, 2011.
5. https://www.arduino.cc/

COURSE OUTCOMES

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

1.Understand the basic concepts of Embedded system Design

2.Become aware of architecture and commands of Arduino and Raspberry Pi

3.Understanding the fundamentals of IoT

4.Incorporate various IoT protocols based on the application

5.Analyze various applications of embedded systems based on Arduino and Raspberry Pi in IoT

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3	2	1								2		
CO2	2	1	2	3										2	3
CO3	3	1	2	2	2								2	1	
CO4	2	3	3	2	3									2	2
CO5	3	2	2	2	3									3	3

22EIPESCN	MEASUREMENT DATA ANALYSIS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- To expose the students to various measurements and methods for estimating errors.
- To understand fundamental techniques of measurement and data analysis and report presentation.

UNIT I

RANDOM VARIABLE AND DISTRIBUTIONS

Sample Spaces- Events - Axioms – Counting - Conditional Probability and Bayes' Theorem – The Binomial Theorem – Random variable and distributions: Mean and Variance of a Random variable- Binomial-Poisson-Exponential and Normal distributions. Curve Fitting and Principles of Least Squares- Regression and correlation

UNIT II

TEST OF HYPOTHESIS

The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions (Chi-Square, t, F, z). Test of Hypothesis- Testing for Attributes – Mean of Normal Population – One-tailed and two-tailed tests, F-test and Chi-Square test - Analysis of variance ANOVA – One way and two way classifications.

UNIT III

PRESENTATION AND CLASSIFICATION OF DATA

Methods of collection of primary data, Discrete and Continuous Variables, Frequency Distributions, Cumulative Frequency distribution and gives, Bivariate Frequency Distributions; Tabulation of data.

MEASURES OF LOCATION AND DISPERSION

Arithmetic mean-The Arithmetic mean of grouped Data, The Median- The mode- The variance and standard deviation- Interpretation of SD, Chebyshev's Lemma or Rule (for sample)

UNIT IV

GRAPHICAL REPRESENTATION

Line graphs, Geometric Forms, Pictorial Diagrams, Control Charts, Radar charts, Parteto Diagrams, Histograms, Pie Charts, Histogram, Scatter diagram, Flow charts
TIME SERIES ANALYSIS: Characteristics Movements in a time series; Time series models; Measurement of Trend; Secular Trend; Seasonal Movements; Cyclical Movements; Irregular Movements; Long Cycles

UNIT V

INTRODUCTION TO R- PACKAGES

Scientific Calculator- Inspecting Variables- Vectors Matrices and Arrays- Lists and Data Frames- Functions- Strings and Factors- Flow Control and Loops- Advanced Looping- Date and Times.
Introduction to Python Packages- Fundamentals of Python- Inserting and Exporting Data- Data Cleansing Checking and Filling Missing Data- Merging Data- Operations- Joins.

REFERENCE BOOKS

1. Richard Cotton, “Learning R”, O’Reilly, 2013.
2. Dalgaard, Peter, “Introductory statistics with R”, Springer Science & Business Media, 2008.
3. Brain S. Everitt, “A Handbook of Statistical Analysis Using R”, Second Edition, 4 LLC, 2014.
4. Samir Madhavan, “Mastering Python for Data Science”, Packt, 2015.
5. Sheldon M. Ross,”Introduction to Probability and Statistics for Engineers and Scientists”, 4th edition, Academic Press; 2009.
6. Paul Teetor, “R Cookbook, O’Reilly, 2011.
7. Mark Lutz ,”Learning Python”, O’Reilly,5th Edition,2013

COURSE OUTCOMES

1. To review basics of measurements
2. To expose on methods for estimating errors and uncertainties of measurements that are performed in industry, commerce and experimental research.
3. To understand the errors in direct measurement.
4. To clarify on the importance of indirect measurements.
5. To introduce the fundamental techniques of measurement and data analysis and to report the results of an experiment.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2											1		
CO2	2	1											1	2	
CO3	2	1	1	2									3	2	
CO4		2	1	2	3								1	1	
CO5	2		2	3									2	**2**	

22EIPESCN	INSTRUMENTATION FOR AGRICULTURE	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- Understand sensors used in agriculture field
- Know continuous and batch process
- Know greenhouse automation schemes

UNIT I
INTRODUCTION

Necessity of instrumentation and control for agriculture sensor requirement, remote sensing, biosensors in agriculture, standards for food quality Soil Properties & Sensing : Properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength, Mohr's circle of stress, active & passive earth pressures, stability & slopes, Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouples, open & close path gas analyzers

UNIT II
INSTRUMENTATION IN CONTINUOUS & BATCH PROCESS

Flow diagram of sugar plant, sensors & instrumentation set up, Flow diagram of fermenter & control (batch process), flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up.

UNIT III
INSTRUMENTATION IN IRRIGATION

Water distribution & management control, Auto drip & sprinkler irrigation systems, irrigation canal management systems, upstream & downstream control concept, SCADA for DAM parameters & control.

UNIT IV
GREENHOUSE PARAMETERS & INSTRUMENTATION

Greenhouse effect, Concept & construction of green houses, merits & demerits, ventilation, cooling & heating, wind speed, temperature & humidity, soil moisture, rain gauge, carbon dioxide enrichment measurement & control, Leaf area length evapo-transpiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis.

UNIT V
APPLICATIONS IN AGRICULTURAL AND FOOD PRODUCTS

Automation in earth moving equipment & farm equipments, application of SCADA & PLC in packing industry and cold storage systems, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation.

TEXT BOOKS

1. B.G.Liptak, Instrumentation handbook-process control, Chilton.
2. C.D. Johnson, Process control and instrumentation technology, PHI

REFERENCE BOOKS

1. R.A Kepner and Roy Bainer, Principle of Farm Machinery, CBS Publication
2. Radhey Lal, Agricultural Engineering, Saroj Publication
3. Patranabis, Industrial instrumentation, TMH

COURSE OUTCOMES:

1. Explain soil properties and sensors used to measure
2. Demonstrate continuous and batch process
3. Understand Irrigation system to develop SCADA based management & control
4. Develop automation scheme for green house
5. Develop SCADA & PLC based solutions in food processing industries

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2								2	1	3
CO2	2	2	2	1	3								1		3
CO3	3	3	3	3	2								1	2	2
CO4	2	2	3	2	3	2							1	3	3
CO5	3	2	3	3	3	2	3						3	3	3

22EIPESCN	AUTOMOTIVE INSTRUMENTATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To know about the Automotive.
- To know about the warning Instruments and Control Switches.

UNIT I

AUTOMOBILE PANEL METERS AND SENSOR DESIGN

Ergonomics- Panel Meters- Controllers- Sensor for Fuel Level in Tank, Engine Cooling-Water Temperature Sensors Design, Engine Oil Pressure Sensor Design, Speed Sensor, Vehicle Speed Sensor Design, Air Pressure Sensors, Engine Oil Temperature Sensor.

UNIT II

INDICATING INSTRUMENTATION DESIGN

Moving Coil Instrument Design, Moving Iron Instruments, Balancing Coil Indicator Design, Ammeter and voltmeter- Odometer and Taximeter Design.Design of Alphanumeric Display for Board Instruments.

UNIT III

WARNING AND ALARM INSTRUMENTS

Brake Actuation Warning System. Traficators, Flash System, Oil Pressure Warning System, Engine Overheat Warning System, Air Pressure Warning System, Speed Warning System. Door Lock Indicators, Gear Neutral Indicator, Horn Design, Permanent Magnet Horn, Air Horn, Music Horns

UNIT IV

DASH BOARD AMENITIES

Car Radio Stereo, Courtesy Lamp, Timepiece, Cigar Lamp, Car Fan, Windshield Wiper, Window Washer, Instrument Wiring System and Electromagnetic Interference Suppression, Wiring Circuits for Instruments, Electronic Instruments. Dash Board Illumination

UNIT V

SWITCHES AND CONTROLS

Horn Switches, Dipper Switches, Pull and Push Switches, Flush Switches, Toggle Switches, Limit Switches, Ignition Key, Ignition Lock, Relay and Solenoid. Non-contact Switches

TEXT BOOKS

1. Walter E, Billiet and Leslie .F, Goings, 'Automotive Electric Systems', American Technical Society, Chicago, 1971.
2. Judge.A.W, 'Modern Electric Equipments for Automobiles', Chapman and Hall, London, 1975.

REFERENCE BOOKS

1. Sonde.B.S., 'Transducers and Display System', Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1977.
2. W.F. Walter, 'Electronic Measurements', Macmillan Press Ltd., London.

3. E.Dushin, 'Basic Metrology and Electrical Measurements', MIR Publishers, Moscow, 1989

COURSE OUTCOMES

1. To understand the basic concepts of automobile panel meters and sensors. (Unit I)
2. To familiarize the design of indicating instrumentation.(Unit II)
3. To demonstrate how to accomplish warning and alarm instruments. (Unit III)
4. To become familiar with dashboard amenities. (Unit–IV)
5. To develop skill in the usage of control switches. (Unit V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	2			1					3		1
CO2		2	3	2	2									2	1
CO3	3	1		2	2								2		2
CO4	3		1	3	2			2					2	2	1
CO5	2	1		3	2								2		2

22EIPESCN	INSTRUMENTATION SYMBOLS AND STANDARDS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

1. To impart basic knowledge on Instrumentation standards, principles and its behavior.
2. To make students familiarize with Instrumentation Symbols, Abbreviations and Identification of Instruments to create Piping and Instrumentation Diagrams for Process Industries

UNIT I

INSTRUMENT SYMBOLS AND STANDARDS

Instrumentation standards: Purpose, Industry codes and standards, Government Regulations - Application to Industries, Application to work activities - Application to classes of Instrumentation and to Instrument functions. Identification Systems: Identification System guidelines: Instrument Index – Multipoint, Multivariable and Multifunction devices – System Identification – Loop Identification number – Identification Letter Tables.

UNIT II

GRAPHIC SYMBOL SYSTEMS

Instrument Line symbols - Measurement and control devices - AND/OR function symbols – Discrete devices – Shared continuous devices – Shared On/Off devices - Multipoint, Multifunction, Multivariable devices and loops. Primary elements – Final control elements – Electrical schematic symbols.

UNIT III

FUNDAMENTALS OF P&ID DEVELOPMENT

Identification of P&ID and its role in process industries - P&ID Development Activity- Anatomy of a P&ID Sheet - Title Block - Ownership Block - Reference Drawing Block - Revision Block - Comments Block - Main Body of a P&ID. Pipes and Equipments: Fluid Conductors: Pipes, Tubes, and Ducts - Pipe Identifiers - Pipe Symbol - Pipe Tag - Pipe fittings. Manual Valves and Automatic Valves - classification of valves – valve operators – Actuators – Tagging Automatic valves – valve positions. Heat Transfer units: Heat exchanger identifier – Heat exchanger identifier Symbol – Heat exchanger Tag - Heat exchanger P&ID.

UNIT IV

INSTRUMENTATION AND CONTROL SYSTEM

Fundamentals of Instrumentation and Control - ICSS System Technology - ICSS Elements - Basic Process Control System (BPCS) -Instruments on P&IDs - Instrument Identifier - Signals: Communication Between Instruments - Different Instrument Elements - Simple control loops - Level Control Loops -Pressure Control Loops -Temperature Control Loops - Composition Control Loops - Flow Control Loops.

UNIT V

PLANT INTERLOCKS AND ALARMS

Introduction- Safety strategies – Concept of a SIS – SIS extent – Anatomy of a SIS: SIS Element Symbols, SIS Final Elements, SIS Logic – Showing Safety Instrumented Functions on P&IDs – Discrete Control – Alarm System: Anatomy of Alarm systems, Alarm requirements, Alarm system Symbology, Concept of 'Common Alarm'.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Ernest E. Ludwig, "Applied Process Design for Chemical and Petrochemical Plants, Vol-I", 4th Edition, Gulf Publishing Company, Houston, 2007.
2. ISA standard 5, "Documentation of Measurement and Control Instruments and Systems", ISA, North Carolina, USA.
3. ISA standard 12, "Electrical Equipment for Hazardous Locations", ISA, North Carolina, USA.
4. ISA standard 20, "Instrument Specification Forms", ISA, North Carolina, USA.
5. ISA standard 37, "Measurement Transducers", ISA, North Carolina, USA. 104
6. ISA standard 75, "Control Valve Standards", ISA, North Carolina, USA.
7. ISA standard 96, "Valve Actuator", ISA, North Carolina, USA.
8. ISA standard 77, "Fossil Power Plant Standards", ISA, North Carolina, USA.
9. ISA standard 67, "Nuclear Power Plant Standards", ISA, North Carolina, USA.
10. BS EN 60584-1, "Thermocouples - EMF specifications and tolerances", British Standard, 2013.

COURSE OUTCOMES

1. Summarize the basics of Instrumentation standards and symbols.
2. Identify the Instrument symbols and Function symbols for various elements.
3. Interpret the symbols of pipes and various equipments in Process industry and recognize P&ID and its role in Process industry.
4. Implement the Control concepts in Basic Process Systems and develop simple control loops.
5. Develop the Safety Interlock Systems and Alarm Systems in Process Plants and equipments.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1									2		1
CO2	2	1	1										2	1	2
CO3	2	2	2	1									2	2	3
CO4	3	2	1	1									3	2	1
CO5	2		2										2		2

22EIPESCN	ADVANCES IN PID CONTROL	L	T	P	C
		3	-	-	3

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.
2. Implement Anti-windup strategies.
3. Design a PID controller.
4. Understand the robust performance.
5. Understand the need for Adaptive PID control.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1								3	3	
CO2	2	3	3	1	1								2	2	
CO3	1	2	3	2	2								2	2	
CO4	3	2	1	2	2								2	3	
CO5	3	2	1	2	2								2	2	

22EIPESCN	CALIBRATION SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To impart knowledge about the calibration principles
- To understand the concept of calibration documentation, instrument calibration for pressure, level, flow and electrical instruments.

UNIT I

CALIBRATION PRINCIPLES

Calibration – Characteristic – requirement of Calibration - Characteristics of a Control System Technician- Loop Calibration and Individual Instrument Calibration - Bench Calibration from Field Calibration - standard operating procedures - tools and equipment - types of measuring instruments - zero, span and range checks.

UNIT II

CALIBRATION DOCUMENTATION

Calibration Procedure - P&IDs and Loop Diagrams - Project Specifications and Manufacturer's Specifications – Calibration Intervals - schedule of testing/calibration plans - tolerance levels - Safety Considerations - tools and equipment required for calibration.

UNIT III

PRESSURE AND LEVEL INSTRUMENT CALIBRATION

Types of Pressure Instruments - Challenges When Calibrating Pressure - Pressure Gauges - Pressure Transmitters - Pressure Switches - Types of Level Instruments - Special Considerations with Level Calibration - Differential Pressure Level Transmitter - Capacitance Level Instrument - Ultrasonic Level Instrument.

UNIT IV

FLOW INSTRUMENT AND FINAL CONTROL DEVICES CALIBRATION

Types of Flow Instruments - Flow meters - D/P Transmitter Calibration - Magnetic Flow meter - Flow meter Using a Master Meter - Gravimetric Method - Calibration with Measurement by Weight - I/P Transducer - Valve Positioner - Control Valve.

UNIT V

CALIBRATION OF ELECTRICAL MEASURING INSTRUMENTS

Types of Electrical Measuring Instruments - Challenges When Calibrating Pressure – Voltmeter - Ammeter - Shunt, CT/PT - Frequency Meter – Wattmeter - single and three phase energy meter - Harmonic analyzers - Digital multi meter and megger - standards of ISO/IEC 17025 - need of NABL Certification.

COURSE OUTCOMES

1. Explain the various Calibration Principles used for measuring instruments
2. Illustrate the documentation process involved in Calibration of measuring instruments
3. Interpret the methods of Pressure and Level Instrument Calibration
4. Interpret the methods of Flow Instrument and Final Control Devices Calibration
5. Interpret the methods of Electrical Measuring Instruments

TEXT BOOK

1. Mike Cable, "Calibration a Technician's Guide ", ISA Technician Series, International Society of Automation, USA, 2005.

REFERENCES:

1. Alessandro Brunelli, "Calibration Handbook of Measuring Instruments", 1st Edition, International Society of Automation,USA, 2017.
2. Rajput R. K., "Electrical Measurement and Measuring Instruments", 4th Edition S. Chand & company Pvt. Ltd., New Delhi, 2008

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		2								3	3	
CO2	2	2	1										2		
CO3	2	2		2											
CO4	2	2	1	2									2	3	
CO5	2				2								3	2	

22EIPESCN	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 – ARM ualtor – 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.
2. Programming the ARM processors.
3. Design of operating system for advanced microcontrollers.
4. By the end of this course, the students will be able to know about the functions and operations of the ARM processor.
5. Develop assembly code for various applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3												3	2	
CO3	3		2										3	2	
CO4	3			3									3	2	
CO5	3			2									3	2	

22EIPESCN	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 and Genetic 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

INTRODUCTION TO NEURAL NETWORKS

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

UNIT II

ARCHITECTURE AND ALGORITHMS

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

UNIT III

APPLICATIONS OF NEURAL NETWORKS

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

TEXT BOOKS

1. Laurene Fausett, 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. Nageswara Rao, 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. Chander Mohan, 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.
2. Derive the different algorithms.
3. Understand the concept of neuro controller.
4. Understand the basics of fuzzy logic controller.
5. Understand the concept of fuzzy control.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	2			2										
CO3	3	2			2									3	
CO4	3	2			2									3	
CO5	3	2			2								3	2	

22EIPESCN	POWER PLANT INSTRUMENTATION	L	T	P	C
		3	-	-	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.
2. Ability to understand the types of measuring equipment used in thermal power plant.
3. Ability to identify and analyze the specific features of different types of control techniques used in Boilers.
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.
5. Ability to understand the function of nuclear power plant, various sensors, control loops and safety measures employed in nuclear power plant.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1					1						3	1	
CO2	3	2	1	1	1		1						2	1	
CO3	1	3	3	2	2		1						2	3	
CO4	3	2	3	3	2		1						3	3	2
CO5	3	1	2	2	1		1						3	2	2

22EIPESCN	INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

1. To know the automated learning techniques.
2. To study the techniques of knowledge representation.

UNIT I

INDUSTRY 4.0

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.

UNIT II

MACHINE LEARNING

Machine Learning - Introduction – Definition – Types of Machine Learning – Supervised, Unsupervised, Reinforcement Learning – Algorithms for Machine Learning – Problems solved by Machine Learning - Tools for Machine Learning - Applications areas of Machine Learning.

UNIT III

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI - environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI.

UNIT IV

ROBOTIC PROCESS AUTOMATION (RPA)

Robotic Process Automation (RPA): Introduction to RPA – Need for automation – Programming constructs in RPA – Robots and Softbots – RPA architecture and process methodologies - Industries best suited for RPA - Risks & Challenges with RPA.

UNIT V

APPLICATIONS AND TOOLS OF INDUSTRY 4.0

Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defence – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics. Applications of Industrial Automation Systems using Machine Learning & Artificial Intelligence.

TEXT BOOKS

1 P. Kaliraj, T. Devi, Higher Education for Industry 4.0 and Transformation to Education 5.0, 2020

REFERENCE BOOKS

1 Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, Third Edition, Pearson Publishers, 2015

2 S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, Second Edition, Wiley India, 2007

COURSE OUTCOMES

1. Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals.
2. Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services.
3. Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits.
4. Evaluate the effectiveness of Cloud Computing in a networked economy.
5. To apply Industry 4.0 concepts in various area like Healthcare, Agriculture etc.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	2		2	1									1	1	3
CO3	2	2	3	2	3								2	1	2
CO4	2	3	2	2	1								2		1
CO5	2	2	2	2	3								2	2	3

22EIPESCN	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. Mukesh Sighal 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. Understand the basis of Operating System.
2. Know the fundamentals of interaction of OS with a computer and User computation.
3. To programming logic of modeling Process based on range of OS features.
4. To design and development of solutions using RTOS.
5. To develop applications using RTOS.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	1		1									2	2	
CO3	2	1	2	2	2								2	1	
CO4			3	2	2									3	
CO5			3	3	3									3	

22EIPESCN	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 networksOn-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.
2. Handle technology dependent parameters in the fabrication process effectively.
3. Perform delay analysis and testability properties of combinational logic networks including both interconnect and gates.
4. Design an architecture that executes the desired function and that meets area, performance and testability constraints.
5. Know issues in CMOS chip testing and the methods for incorporating test considerations into chips from the start of the design.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3									1	3
CO2	3	3	1	2	3									1	2
CO3	3	3	1	2	3									1	2
CO4	3	3	3	2	3									2	3
CO5	3	3	3	2	3									2	3

22EIPESCN	UNIT OPERATIONS AND CONTROL	L	T	P	C
		3	-	-	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	2											3		
CO3	3	2	2	2									3	1	
CO4	3	2	2	2									3	1	
CO5	3	2	3	3	3								3	2	3

22EIPESCN	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. Henk Nimeijer, 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	2											3		
CO3	3	2	2	2									3	1	
CO4	3	2	2	2									3	1	
CO5	3	2	3	3	3								3	2	3

22EIPESCN	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1	1									3		
CO2	3												3		
CO3	3	2	3	2	1									3	
CO4	3	1	3	2	2									3	
CO5	3	-	-	-	2								3		

22EIPESCN	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 STR
UCTURED 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											3		
CO2	2	3	1	2									2	2	
CO3			3	2										2	
CO4			3	2										2	
CO5	3			2	2								3	2	

22EIPESCN	BUILDING AUTOMATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- Understand basics alarm system
- Know security system
- Understand HVAC

UNIT I
ALARM SYSTEMS

What is fire, fire modes, FAS components: Field components, panel components, applications FAS architecture: Types and examples. FAS loops : Classification of loops Power supply design for FAS, Fire standards: FAS design procedure in brief, NFPA 72A, BS 5839, IS 08 2 Security System:

UNIT II
SECURITY SYSTEMS

Introduction of security system, concepts, Access control components, Access control system design.

UNIT III
HVAC SYSTEMS

Introduction: HVAC fundamentals, properties of air, psychometric chart, heat transfer mechanisms, Human comfort zones, effect of heat humidity and heat loss.

UNIT IV
PROCESS APPLICATIONS

Heating process and applications (ie. Boiler & Heater), cooling process and applications (ie.Chiller), ventilation process & application (ie.Central fan systems, AHU, Exhaust fans), Unitary systems.

UNIT V
CONTROL PANEL

HVAC control panel, MCC Basics, Panel components Energy Management: Advantages of BMS, energy saving concepts & methods, lightning control, Lightening control, Building efficiency improvement, Green building concepts.

TEXT BOOKS

1. Robert Gagonon, Design of special hazards and fire alarm systems, 2007
2. Thomos L Norman, Integrated security system design: Concepts, specification & implementation, CRC, 2017
3. Levenhagen, John I. Spethmann and Fonald H HVAC control and systems, Wiley, 2017.
4. Building control system application and guide by CIBSE,2000

COURSE OUTCOMES:

1. Describe alarm system

2. know security system
3. Identify processes in HVAC
4. Explain Energy management systems
5. Understand energy saving & efficiency improvement concepts in buildings

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	2											2		
CO3	3	2		2									2		
CO4	3	2			3								3	1	
CO5	3		3	3	3	3	2						3	2	

22EIPESCN	MULTI SENSOR DATA FUSION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To introduce the basic concepts of sensor systems, the need for multi-sensor data fusion and various approaches to data fusion.
- To provide an insight into importance of sensor management and data association in the context of sensor fusion.

UNIT I
MULTISENSOR DATA FUSION INTRODUCTION

Sensors and sensor data, Use of multiple sensors, Fusion applications. The inference hierarchy: output data. Data fusion model.Architectural concepts and issues. Benefits of data fusion, Mathematical tools used:Algorithms, co-ordinate transformations, rigid body motion. Dependability and Markov chains, Meta – heuristics.

UNIT II
ALGORITHMS FOR DATA FUSION

Taxonomy of algorithms for multisensor data fusion.Data association.Identity declaration.

UNIT III
ESTIMATION

Kalman filtering, practical aspects of Kalman filtering, extended Kalmal filters. Decision level identify fusion. Knowledge based approaches.

UNIT IV
ADVANCED FILTERING

Data information filter, extended information filter. Decentralized and scalable decentralized estimation.Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion.

UNIT V
HIGH PERFORMANCE DATA STRUCTURES

Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures.Designing optimal sensor systems with in dependability bounds.Implementing data fusion system.

TEXT BOOKS

1. David L. Hall, Mathematical techniques in Multisensor data fusion, Artech House, Boston, 1992.
2. R.R. Brooks and S.S. Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey, 1998.

REFERENCE BOOKS

1. Arthur Gelb, Applied Optimal Estimation, The M.I.T. Press, 1982.
2. James V. Candy, Signal Processing: The Model Based Approach, McGraw – Hill Book Company, 1987.

COURSE OUTCOMES

1. Understand the importance of using data fusion in multi-sensor systems.
2. Apply algorithms for multi sensor data fusion.
3. Apply Kalman filtering to data fusion problems.
4. Apply filtering and estimation concepts in data fusion.
5. Interpret high performance data structures.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1										3		
CO2	2	1	2	1	2									3	
CO3	2	1	3	1	2									3	
CO4	2	2	3	2	3								2	3	
CO5	3	2	1	3	2								2	1	

OE - OPEN ELECTIVES

22EIOESCN	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
SCIENCE OF MEASUREMENTS AND CHARACTERISTICS OF TRANSDUCERS

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
RESISTANCE TRANSDUCERS

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

UNIT III
INDUCTIVE, CAPACITIVE AND TACHO TRANSDUCERS

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

UNIT IV
PIEZO ELECTRIC AND HALL EFFECT TRANSDUCERS

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

UNIT V
FIBRE OPTIC AND SMART SENSORS

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).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1		1										1		
CO3	1		1										2		
CO4	2		1										1	2	
CO5	2		2	2	1								2	2	

22EIOESCN	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
MEASUREMENT OF ELECTRICAL QUANTITIES

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
SIGNAL SOURCES AND ANALYSERS

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 current and voltage measuring instruments such as ammeters, voltmeters,extension of range of meters, current and voltage transformersused to measure electrical quantities. (Unit I)
2. Able to understand the principle of different types of watt meters employed for power measurement. (Unit II)
3. Able to design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement. (Unit-III)
4. Able to understand the principle of analog and digital measurements and principle of energy meter. (Unit-IV).
5. Familiar with the operation and usage of various analysing instruments. (Unit-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											1		
CO2	2	2	1										1		
CO3	1	2	2	1									2		
CO4	1	1	1		1								1	3	
CO5	1	2			2								1		

22EIOESCN	INDUSTRIAL MEASUREMENTS	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

Calibration of Pressure, level measuring instruments and Flow meters, 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 measuring instruments and principle of pressure transmitters used in industries. (Unit-II)
3. Able to identify or choose proper level measuring device for specific process measurement. (Unit-III)
4. Familiar with the different flow measurement techniques used in process industries. (Unit-IV)
5. Familiar with calibration of various flow measuring instruments used in industrial flow measurement.(Unit-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1		1								2	2	1
CO2	2		1		2								2	2	1
CO3	2		1		2								2	2	1
CO4	2		1		2								2	2	1
CO5	3	2	1		3								2	2	

22EIOESCN	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

PROGRAMMABLE LOGIC CONTROLLERS (PLCS): AN OVERVIEW

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

PLC PROGRAMMING

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

HIGHER LEVEL PLC LANGUAGES

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

DISTRIBUTED CONTROL SYSTEM (DCS)

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

UNIT V

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

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. Familiarize with the history and advancement of Automation and PLCs in Industries (Unit I)
2. Design and development of PLC ladder programming for simple process applications. (Unit II)
3. Know about the higher level programming languages for PLC. (Unit-III)
4. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system. (Unit-IV)
5. Know the latest communication technologies like HART and Field bus protocol (Unit-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1			1								1		
CO2	1	2	3		2								1	2	1
CO3	1	2	3		2								1	2	3
CO4	1	1	2		2								1	2	3
CO5	1	1	2		2								1	2	3

22EIOESCN	ELECTRONIC DESIGN AND FABRICATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To create knowledge in Arduino platform.
- To gain knowledge about various sensors and actuators.
- To be familiar with real time electronic systems using Arduino.

UNIT I

INTRODUCTION TO ELECTRONIC SYSTEM DESIGN

Building blocks of electronic system design– Key Design Metrices- Introduction to Analog I/O – Digital I/O – Introduction to Arduino platform- Hardware features – Types of Arduino boards – Features of Arduino Uno - pin details - Arduino IDE – configuration settings - basic sketch in Arduino – compiling and downloading sketches.

UNIT II

ARDUINO FIRMWARE DEVELOPMENT

Data types, operators, Decision Making statements, Looping statements, Arrays, Functions, Classes, Arduino Libraries, debugging. Built in I/O Functions, Programming digital I/O, analog I/O, UART communication, PWM and Interrupt programming - Intel Hex File format.

UNIT III

PERIPHERALS AND SENSORS

Peripherals: LEDs, switches, Relays, Buzzers, Seven segment displays, keypads, Character LCDs, graphical LCDs, SD card memory, DC and Servomotors. Sensors: Temperature, Infrared, Moisture and Humidity sensor, Pressure, Light, Gas Sensor, Motion Sensor, Speed, PIR Sensor, Accelerometer.

UNIT IV

DESIGN OF ELECTRONIC SYSTEMS

Study of temperature control system – Robotic system using DC motors – Ultrasonic Range system – Security system using sensors – weather monitoring system – Street light control system – GSM based systems – WiFi and Bluetooth based systems – PC based Measurement and Control.

UNIT V

PCB DESIGN AND FABRICATION

Introduction to PCB Designing - Steps in PCB Designing and Manufacturing- Electronics Components and their Packaging- Schematic Editor - Schematic Diagram - Board/Layout Editor- Converting Schematic into Board - Layers - Routing - Important Guidelines and standards - Gerber file generation.

REFERENCE BOOKS

1. Simon Monk, Programming Arduino Next Steps: Going Further with Sketches, Mc Graw Hill Education-2019.
2. Michael Margolis, Arduino CookBook, Oreilly-2011.
3. Jeremy Blum, Exploring Arduino, Wiley-2012.
4. Mark Geddes, Arduino Project Handbook: Volume one: Complete Guide to Creating with the Arduino, Sketch Publishing-2014.
5. Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, Arduino Programming From Beginning to Advanced, Micro Digital-Ed-2018.

COURSE OUTCOMES

1. The student will gain conceptual understanding of Arduino Platform
2. The students will become knowledgeable about firmware development using arduino platform
3. The students will gain knowledge about sensors and peripheral devices.
4. The students will learn about design of real time electronic systems using arduino.
5. Student will get understanding of PCB designing and fabrication.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1													1		
CO2	2		1										1	2	
CO3	2	1	1		2								1	2	
CO4	2	2	3	2	2								1	1	
CO5	2	2	2	2	2								1	**2**	

22EIOESCN	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	-	-	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

FUNDAMENTALS OF BIOMEDICAL ENGINEERING

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

BIOSENSORS, ELECTRODES AND REORDERS

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

IMAGING MODALITIES AND ANALYSIS

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

ELETRICAL PARAMETERS ACQUISITION AND ANALYSIS

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

LIFE ASSISTING AND THERAPEUTIC DEVICES

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1	1			2								1	2	
CO3	2	2	2		3								1	2	
CO4	2	2	1	2	2								2	2	
CO5	2	2	2	2	3	2							2	3	

22EIOESCN	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 based on electrostatic and thermal actuation principles.
- To study the design concepts of MEMS devices based on piezoresistive and piezoelectric actuation principles.
- To study about the polymers and applications of MEMS devices based on various actuation principles..

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.

UNIT III

SENSORS AND ACTUATORS-I

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation.

UNIT IV

SENSORS AND ACTUATORS-II

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT V

POLYMER AND OPTICAL MEMS

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

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.
3. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.

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.
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

COURSE OUTCOMES

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

1. Fundamentals of Micro Electro Mechanical Systems (MEMS) will be studied by the students (Unit-I).
2. Knowledge of fundamental concepts of MEMS fabrication processes will be gained (Unit-II).
3. Design concepts of various MEMS devices based on Electrostatic and Thermal principles will be developed. (Units II, III and IV)
4. Design concepts of various MEMS devices based on Piezoresistive and piezoelectric principles will be developed. (Units II, III and IV)
5. Principles of Polymers and applications of MEMS devices such as Accelerometers, Pressure Sensors and Actuators will be implemented (Units III, IV and V).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	1											2		
CO3	2	2	1	2									2	1	
CO4	2	2	2	2									2	2	
CO5	2	2	2	2	3								2	2	

22EIOESCN	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 forsynthesis 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 nano structuring-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 andApplications, 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 nanoelectronics devices. (Unit III)
4. To understand Nano-material (Unit V)
5. To understand the behavior and application of carbon nano tubes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	2												2		
CO3	1		2										1		
CO4	2		2										2		
CO5	2		1	2									2		

22EIOESCN	INSTRUMENTATION AND CONTROL IN PROCESS INDUSTRIES	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- This course provides the concepts of various processes in process Industries such as process, paper, steel, dairy products, pharmaceutical and fermentation.
- This course emphasizes the Instrumentation and Control techniques involved in such units.

UNIT I

BASICS OF PROCESS MEASUREMENTS

Continuous vs. discrete measurement – Continuous vs. Sampled measurement – In-line, On-line and Off-line – Measurement uncertainty – Measurement decision risk –Calibration – Measurement device components – Current loop – Power supply and Wiring –Serial communications – Smart transmitters.

UNIT II

INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES

Process description in diagrammatic and functional block details – Digester blow tank controls – Digester liquor feed pump control – Brown stock washer level control – Stock chest level control – Dissolving tank density control – White liquor classifier density control –White liquor flow control – Dryer temperature control

UNIT III

INSTRUMENTATION AND CONTROL IN STEEL INDUSTRIES

Process description in diagrammatic and functional block details – Raw materials preparation – Operation of Blast Furnace (BF)– Basic Oxygen Furnace (BOF) – Electric Furnace (EF) – Open Hearth Furnace (OHF) – Gas and water control system in Basic oxygen furnace–Mold level control system in strand casting operation

UNIT IV

INSTRUMENTATION AND CONTROL IN DAIRY INDUSTRIES

Process description in diagrammatic and functional block details–Plate heat exchanger – Single stage and Two stage Homogenizer – Doppler ultrasonic flow meter – Air operated milk valve – Control system in HTST pasteurizer– Temperature control in spray dryer – Automation for Cleaning in Place (CIP)-Metal detection system – Refrigeration System.

UNIT V

INSTRUMENTATION AND CONTROL IN PHARMACEUTICAL AND FERMENTATION INDUSTRIES

Description of the penicillin production process – flow measurement – Level measurement – Pressure measurement – Temperature measurement – Fermentation

control system – Continuous fermentation – pH control – Temperature control – Centrifuge purging control.

COURSE OUTCOMES

1. Explain the basics of process measurements in various industries.
2. Develop the instrumentation and control systems in paper industry.
3. Build the instrumentation and control techniques involved in iron and steel industry.
4. Apply the various instrumentation and control schemes in dairy industry
5. Interpret the knowledge on instruments used in pharmaceutical and fermentation industry

TEXT BOOK:

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

REFERENCES:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	2	1	2		2								2	3	2
CO3	1	1	2		2								1	2	3
CO4	1	2	2		2								1	3	2
CO5	2	2	2	3	2								1	3	3

22EIOESCN	MEDICAL IMAGING SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To know the fundamentals of Medical imaging systems
- To introduce various technologies to capture the Images for the physiological systems
- To impart knowledge on Advanced Medical Imaging modalities
- To introduce research knowledge on Medical Image processing techniques

UNIT I
BASICS OF NUCLEAR MEDICINE

Radioactivity and interaction of radiation; Alpha, Beta and gamma emission, Laws of radioactive decay, Mechanisms of radioactive delay, Radiation intensity and exposure, Decay schemes and energy levels, Compton scattering, Pair productions, Particle interactions

UNIT II
PET AND SPECT IMAGING

Introduction to emission tomography, basic physics of radioisotope imaging Compton cameras for nuclear imaging, PET scanner principles, SPECT, Computer techniques in fast acquisition Analytic image reconstruction techniques, Attenuation, scatter compensation in SPECT spatial compensation in SPECT.

UNIT III
ULTRASONIC IMAGING

Production of ultrasound – properties and principles of image formation, capture and display – principles of A-mode, B-mode and M-mode display – Doppler ultra sound and color flow mapping – applications of diagnostic ultra sound.

UNIT IV
INFRA-RED IMAGING

Physics of thermography – imaging systems – pyroelectric Videocon camera clinical thermography – liquid crystal thermography.

UNIT V
OTHER IMAGING TECHNIQUES

Optical coherence tomography (OCT): Introduction and its medical applications - Advances in image resolutions - Speed in Picture Archiving and Communication Systems (PACS) in medical imaging.

TEXT BOOKS

1. Simon Cherry, James Sorenson, Michael Phelps. “Physics in Nuclear Medicine”, Elsevier Saunders, 4th Edition, 2012.
2. John Ball and Tony Price Chesney’s, “Radiographic Imaging”. Blackwell Science Limited, U.K. 2006.
3. Farr, “The Physics of Medical Imaging”, Adem Hilger, Bristol & Philadelphia, 2007.
4. Joseph Bronzino. “The Physics of Medical Imaging”. Second edition.2005.

REFERENCE BOOKS

1. M. Analoui, J.D. Bronzino, D.R.Peterson, “Medical Imaging: Principles and Practices”, CRC Press, 2012.
2. S. Webb, “Physics of Medical Imaging”, Taylor & Francis, 2010.
3. T. Farncombe, K. Iniewski, “Medical Imaging: Technology & Applications”, CRC Press, 2013.
4. J.S. Benseler, “The Radiology Handbook: A pocket guide to medical imaging”, Ohio University Press, 2006.

COURSE OUTCOMES

1. Students will know the basics of Medical Imaging.
2. Knowledge acquired by the students on physiology of human system.
3. Students were introduced knowledge on advanced Imaging Technologies.
4. Students can able to posses research knowledge on Medical Image processing techniques.
5. The knowledge on application of processing algorithms were acquired by the students.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1			2	1								2	1	
CO3	1			2	2								1	2	
CO4	1	1	1	3	1								1	1	
CO5	2	1	2	1									2	2	

22EIOESCN	DIAGNOSTICS AND THERAPEUTIC INSTRUMENTS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To make awareness to the students about the various biomedical equipments.
- To understand the physiological measurement devices
- To gain knowledge and importance of medical devices maintenance

UNIT I
CARDIAC EQUIPMENTS

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types. EEG diagnostic interpretation, recording and analysis of EMG waveforms.

UNIT II
RESPIRATORY INSTRUMENTS

Heart lung machines - Need for the unit, functioning of bubble, disc type and membrane type oxygenerators, finger pump, roller pump, electronic monitoring of functional parameter. Spirometer, Respiratory volume measurement, pnemograph, artificial respirator – IPR type, functioning, Pulse Oximetry.

UNIT III
INSTRUMENTS DEALING WITH KIDNEYS AND BONES

Regulation of Water and Electrolyte Balance – Artificial Kidney – Hemo dialysis -Crafts fordialysis - Peritoneal dialysis - Dialyzers – different types – BMDMeasurements – SXA – DXA - Quantitative ultrasound bone densitometer Principles of Dialysis – Hemodialysis.

UNIT IV
ELECTRICAL STIMULATORS

Electrical stimulators: Strength-duration curve, types of stimulators, an electrodiagnostic therapeutic stimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain and relief. Principles of Cryogenic technique and application, Endoscopy, Laparoscopy, Thermography.

UNIT V
PATIENT MONITORING SYSTEMS

Patient monitoring system – ICU, post operative, ICCU, single channel telemetry, multichannel telemetry. Transmission of Bio signals over telephone lines. Digital central monitoring systems for patient monitoring. Computer based arrhythmia detection system.

TEXT BOOKS

1. Khandpur R.S, 'Handbook of Biomedical Instrumentation', Tata McGraw-Hill, New Delhi, 1997.
2. John G. Webster, 'Medical Instrumentation: Application and Design', Wiley; 3 edition, August 1997.

REFERENCE BOOK

1. Joseph J.carr and John M. Brown, 'Introduction to Biomedical equipment technology', John wiley and sons, New York, 1997.

COURSE OUTCOMES

1. Students will know the basics Medical Instruments.
2. Knowledge acquired by the students on physiology of human system.
3. Students were introduced knowledge on various medical devices.
4. Students can able to posses the maintenance and control of medical devices.
5. The knowledge on various diagnostics methods and therapy was acquired by the students.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					1							1		
CO2	1		1	2	1	2							3	1	
CO3	1		2	2	2	2							1	2	
CO4	1		1	1	1	2							1	1	
CO5	2		2	1		3							3	2	

22EIOESCN	ARTIFICIAL INTELLIGENCE IN INDUSTRIAL AUTOMATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

To impart significance of intelligent techniques in automation of process industries and to make students familiarize with neural network and knowledge-based modeling and diagnosis of industrial automation systems

UNIT I

ARTIFICIAL INTELLIGENCE IN INDUSTRIAL DECISION MAKING, CONTROL AND AUTOMATION

Introduction-Decision Making Theory-Control and Automation-Artificial Intelligence Methodologies-Artificial Intelligence Methodologies: Reasoning under uncertainty - Qualitative reasoning-Neural nets reasoning. Artificial Intelligence in Decision Making-Artificial Intelligence in Control and Supervision-Artificial Intelligence in Engineering Fault Diagnosis.

UNIT II

APPLIED INTELLIGENT CONTROL SYSTEMS

Introduction-Proposed Structure -Intelligent Automatic Generation Control - Intelligent Comfort Control System-Control System Development- Application: Stabilizing a Buckling Column -The column model-. Extracting and representing qualitative phase-space structure of the buckling column-Synthesizing control laws for stabilizing the column.

UNIT III

ARTIFICIAL NEURAL NETWORKS FOR MODELING

Introduction to Artificial neural network -Nonlinear models and ANN-Multilayered static neural networks-Cerebellum model articulation controller-Identification of Dynamic Systems Using ANN-Hybrid Modeling-Model Validation-Experiments and Results Using Neural Identification.

UNIT IV

KNOWLEDGE - BASED SYSTEM DIAGNOSIS

Introduction-Knowledge Representation and Acquisition for Fault Diagnosis (FD) – First and Second - Generation Diagnostic Expert Systems (ES)-FD Methodologies and Second-Generation ES -Digital Systems Diagnostic Tools. Diagnosis with explicit models: Multilevel Flow Modeling (MFM)-Three Diagnostic Methods: Measurement Validation-Alarm analysis -Fault Diagnosis

UNIT V

KNOWLEDGE-BASED INDUSTRIAL SCHEDULING

Introduction-Knowlegde Acquisition-Knowledge Representation-Temporal Issues-Control Mechanisms-Knowledge Based Scheduling Systems-Reactive and Real-Time

Scheduling-reactive Scheduling strategy-IT Systems for management-support in organizations-Groupware taxonomy -Modelling the organizational structure.

TEXT BOOK

1. Jay Lee," Industrial-AI-Applications-Sustainable-Performance", springer publications -2020
2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 5th edition, Pearson Education, 2009.

REFERENCES

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd Edition, Prentice Hall, 2003.
2. Sudip Misra, Chandana Roy, Anandarup Mukherjee, "Introduction to Industrial internet of things and industry 4.0",First edition CRC press, 202Rich and Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2014.

COURSE OUTCOMES

1. Enumerate the role of Artificial Intelligence in Industrial Decision Making, Control and Automation.
2. Understand the concepts of intelligent control systems in industrial automation.
3. Select a suitable neural network modeling for industrial automation.
4. Understand the concepts of Knowledge - Based System Diagnosis.
5. Understand the concepts of Knowledge - Based scheduling.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			2	2								1	2	
CO2	2		1	1	2								2	3	
CO3	2	1	2	1	2								1	2	
CO4	2	1	2	2									1		
CO5	2	1	2	1									1		

22EIOESCN	NCC STUDIES (ARMY WING) - I	L	T	P	C
		2		2	3

Course Objective

This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.

UNIT I (LECTURE)

NCC ORGANISATION AND NATIONAL INTEGRATION

NCC Organisation – History of NCC- NCC Organization - NCC Training- Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Factors affecting national integration.

UNIT II (LECTURE)

PERSONALITY DEVELOPMENT AND LEADERSHIP

Introduction - Factors influencing / shaping Personality - Self-Awareness – Know yourself/ Insight - Communication Skills - Leadership Traits – Types – Attitude - Time Management - Effects of Leadership - Stress Management Skills - Interview Skills - Conflict Motives - Resolution - Importance of Group / Team Work - Influencing Skills - Body Language - Sociability: Social Skills.

UNIT III (LECTURE)

SOCIAL AWARENESS AND COMMUNITY DEVELOPMENT

Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility.

UNIT IV (LECTURE)

SPECIALIZED SUBJECT (ARMY WING)

Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews- Fieldcraft and Battlecraft-Basics of Map reading.

SPECIALIZED SUBJECT (NAVY WING)

Naval Orientation - Naval Communication - Navigation - Seamanship - Fire Fighting Flooding & Damage Control - Ship and Boat Modeling-Swimming Basics.

UNIT – V (PRACTICAL)

BASIC PHYSICAL TRAINING AND WEAPON TRAINING

Basic physical Training – various exercises for fitness (with Demonstration) - Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching (WITH DEMONSTRATION)

Main Parts of a Rifle- Characteristics of .22 rifle- Characteristics of 7.62mm SLR- Characteristics of 5.56mm INSAS rifle - stripping and assembling – position and holding- safety precautions – range procedure- firing simulation.

TEXT BOOK:

1. R.K.Gupta, "National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.

REFERENCES:

1. "Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.
2. "Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3. "NCC OTA Precise", published by DG NCC, New Delhi.

COURSE OUTCOMES

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

1. Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion
2. Acquaint and provide knowledge on personality development, self-awareness, communication skills with leadership traits to work as a team and sociability values
3. Understand about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils
4. Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.
5. Demonstrate health exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders and basic knowledge of weapons and their use and handling.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	2	1	2			
CO2								3	3	3	2	3			
CO3								3	3	2	2	2			
CO4								3	3	3	1	2			
CO5								3	3	3	1	2			

22EIOESCN	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the concepts IPR
- To understand Trademarks, Trade Secretes and GI of goods.
- To understand Copyrights, Patents and Industrial Designs.
- To learn about how to manage IP rights and legal aspects.
- To understand the concepts of Cyber laws in IPR.

UNIT - I

Introduction to Intellectual Property: IPR - Definition - Types of IPR: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R&D; Few Case Studies WTO - Definition - Functions - Forms of IPR Protection.

UNIT–II

Trade Marks: Purpose and function of trademarks, Acquisition of trade mark rights, transfer of rights, Selecting and evaluating trademark, registration of trademarks, claims.

Trade Secrets: Trade secret law, determination of trade secret status, liability for misappropriation of trade secrets, trade secret litigation. Geographical Indication of Goods: Basic aspects and need for the registration

UNIT–III

Copyrights: Fundamentals of copyright law, originality of material, right of reproduction, right to perform the work publicly, copyright ownership issues, notice of copyright.

Patents: Foundation of patent law, patent searching process, Basic Criteria of Patentability **Industrial Designs:** Kind of protection provided in Industrial design

UNIT–IV

Managing IP Rights: Acquiring IP Rights: letters of instruction, joint collaboration agreement.

Protecting IP Rights: nondisclosure agreement, cease and desist letter, settlement memorandum.

Transferring IP Rights: Assignment contract, license agreement, deed of assignment

UNIT-V

Introduction to Cyber law: Information Technology Act, cybercrime and e-commerce, data security, confidentiality, privacy, international aspects of computer and online crime.

REFERENCE BOOKS

1. Bare Act, The Indian Patent Act 1970 and the Patent Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
2. Mittal D.P., Indian Patents Law. Taxmann Allied Services (p) Ltd., 1999.
3. Deborah E Bouchoux, Intellectual Property: Right: The Law of Trademarks, Copyrights, Patents and Trade Secrets, 2012.
4. Gerald R. Ferrera, Cyber law: Text and Cases, South-Western Cengage Learning, 2012.
5. N.K Acharya, Intellectual property rights, Scandinavian Languages Edition, 2021.
6. Kompal Bansal, Fundamentals of Intellectual Property for Engineers, BS Publications 2013.
7. P. Radhakrishna, Intellectual Property Rights: Text and Cases, Excel Books, 2008.

COURSE OUTCOMES

1. Learner should be able to demonstrate understanding of basic concepts of IPR.
2. Able to differentiate between Trademarks, Trade secrets and GI of goods.
3. Able to understand Copyrights, Patents and Industrial Designs.
4. Able to manage and protect IP
5. Will gain Knowledge on Cyber law

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2			2	2			2		
CO2	2					2			2	3			2		
CO3	2					3		3	2	2			2		
CO4	2					2		3	2	3			2		
CO5	2					2		3	2	3			2		

The Syllabi for the Courses that include

14	EIOESCN	Industry 4.0
15	EIOESCN	Machine Learning
16	EIOESCN	Augmented & Virtual Reality (AR VR) Development
17	EIOESCN	Block Chain
18	EIOESCN	Cyber Security
19	EIOESCN	Powering IOT using Raspberry Pi or Arduino
20	EIOESCN	Machine Learning with Application to Object Recognition

Shall be taken from the Naan Mudhalvan Portal since it forms part of the scheme.

HONOUR ELECTIVES

22EIHESCN	MODEL PREDICTIVE CONTROL	L	T	P	C
		3	1	-	4

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	1												1		
CO3	1	2											2	2	
CO4	2	2	2	1	2								2	2	
CO5	1	3	3	2	3								2	3	2

22EIHESCN	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2	2							2		
CO2	2				2	2							2		
CO3	2				2	2							2		
CO4	3		3	2	3	2							3	2	
CO5	2				2	2							2		

22EIHESCN	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–Workvolume– 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-: Lead through Methods, Robot program as a path in space- Motion interpolation, WAIT, SIGNAL and DELAY Commands, Branching, Capabilities and limitations of Lead through Methods- Textual Robot Programming- 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												1		
CO2	2												2		1
CO3	2		2		2								2	2	2
CO4	2	3	2	2	3								2	3	2
CO5	2	2	2	2	2								2	2	3

22EIHESCN	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

INTRODUCTION TO FIBER OPTICS

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 BASED INSTRUMENTATION AND MATERIAL PROCESSING

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

LASER APPLICATIONS

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	2												2		
CO3	2												2		
CO4	2	2											2	2	
CO5	2	2	2		3	2							2	2	

22EIHESCN	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 Gianluca Zito, 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	2				1								2	1	
CO3	2	2	1		2								2	2	
CO4	2	2	2	2	2								2	2	
CO5	2	2	2	3	2								2	2	

22EIHESCN	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 America Publications, 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1	2											1	2	3
CO3	2												2		
CO4	2			2	3								2		3
CO5	2	2	2	2	3								2	2	3

MINOR ENGINEERING

22EIMISCN	SENSORS AND TRANSDUCERS	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

SCIENCE OF MEASUREMENTS AND CHARACTERISTICS OF TRANSDUCERS

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

RESISTANCE TRANSDUCERS

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

UNIT III

INDUCTIVE, CAPACITIVE AND TACHO TRANSDUCERS

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

UNIT IV

ELECTRIC AND MAGNETIC TRANSDUCERS

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

UNIT V

FIBRE OPTIC AND SMART SENSORS

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).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1		1										1		
CO3	1		1										2		
CO4	2		1										1	2	
CO5	2		2	2	1								2	2	

22EIMISCN	ELECTRONIC TESTING 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

MEASUREMENT OF ELECTRICAL QUANTITIES

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

SIGNAL SOURCES AND ANALYZERS

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 current and voltage measuring instruments such as ammeters, voltmeters, extension of range of meters, current and voltage transformers used to measure electrical quantities. (Unit I)
2. Able to understand the principle of different types of watt meters employed for power measurement. (Unit II)
3. Able to design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement. (Unit-III)
4. Able to understand the principle of analog and digital measurements and principle of energy meter. (Unit-IV).
5. Familiar with the operation and usage of various analysing instruments. (Unit-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											1		
CO2	2	2	1										1		
CO3	1	2	2	1									2		
CO4	1	1	1		1								1	3	
CO5	1	2			2								1		

22EIMISCN	INDUSTRIAL PROCESS MEASUREMENTS	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, Electromagnetic flow meters, Hot wire anemometer and ultrasonic flow meters.

UNIT V

CALIBRATION

Calibration of Pressure, level measuring instruments and Flow meters, 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 measuring instruments and principle of pressure transmitters used in industries. (Unit-II)
3. Able to identify or choose proper level measuring device for specific process measurement. (Unit-III)
4. Familiar with the different flow measurement techniques used in process industries. (Unit-IV)
5. Familiar with calibration of various flow measuring instruments used in industrial flow measurement.(Unit-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1		1								2	2	1
CO2	2		1		2								2	2	1
CO3	2		1		2								2	2	1
CO4	2		1		2								2	2	1
CO5	3	2	1		3								2	2	

22EIMISCN	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

CONTROL SYSTEM

Introduction to control system – Open loop and Closed loop system – Feedback system characteristics – Block diagram reduction techniques – Signal flow graph.

UNIT II

SYSTEM PARAMETERS

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

SYSTEM DESIGN AND MEASUREMENT

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

COMPENSATOR DESIGN

Introduction to different compensator design – the design of different compensator design using simulation software. PID controller design using simulation software.

UNIT V

CONTROL APPLICATIONS

Application of control system for different domain with case studies.

TEXT BOOKS

1. I.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

1. Learn the importance of feedback control system. (Unit-I)
2. understand time domain and frequency domain techniques. (Unit-II)
3. understand the stability analysis of control system. (Unit-III)
4. Design and analyse controller and compensator. (Unit-IV)
5. The student is exposed to classical control design using simulation software (Unit-V).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	2												2		
CO3	1	2	2										1		
CO4	1	2	1	2									1		
CO5	2	2	2	2	3								2	1	

22EIMISCN	FUNDAMENTALS OF 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

PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

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

PLC PROGRAMMING

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

HIGH LEVEL PLC LANGUAGES

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

DISTRIBUTED CONTROL SYSTEM (DCS)

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

UNIT V

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

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. Familiarize with the history and advancement of Automation and PLCs in Industries (Unit I)
2. Design and development of PLC ladder programming for simple process applications. (Unit II)
3. Know about the higher level programming languages for PLC. (Unit-III)
4. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system. (Unit-IV)
5. Know the latest communication technologies like HART and Field bus protocol (Unit-V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1			1								1		
CO2	1	2	3		2								1	2	1
CO3	1	2	3		2								1	2	3
CO4	1	1	2		2								1	2	3
CO5	1	1	2		2								1	2	3

22EIMISCN	PRINCIPLES OF MEDICAL ELECTRONICS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand Physiological parameters.
- To gain knowledge about working principle of Assist devices and Biotelemetry.
- To be familiar with instruments used in medical field.

UNIT I

ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING

The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, EOG, lead systems and recording methods, typical waveforms and signal characteristics. CO1

UNIT II

BIO-CHEMICAL AND NON ELECTRICAL PARAMETERS

pH, PO2, PCO2, Electrophoresis, colorimeter, photometer, Auto analyzer,
Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters.

UNIT III

ASSIST DEVICES AND BIO-TELEMETRY

Cardiac pacemakers, DC Defibrillator, Haemodialysis - Telemetry principles, FM/FM Biotelemetry, radio- pill and tele-stimulation.

UNIT IV

MEDICAL IMAGING

Diagnostic x-ray equipments – Fluoroscopy - use of Radio Isotope in diagnosis, Ultrasound Scanner – CT scanner

UNIT V

RECENT TRENDS IN MEDICAL INSTRUMENTATION

Thermograph, endoscopy unit, Laser in medicine, Diathermy units, Electrical safety in medical equipment.

TEXT BOOKS

1. R.Ananda Natarajan, “Biomedical instrumentation and Measurements”, PHI Learning, 3rd edition 2019

REFERENCES

1. 1.J.G. Webster, Medical Instrumentation: Application and Design, John Wiley and Sons, New York, 2010
2. Leslie Cromwell, Biomedical Instrumentation and measurement, Tata McGraw Hill, 2007

COURSE OUTCOMES

1. Understand the basics of Electrophysiology
2. Understand the principle of Physiological parameters
3. Learn the working principle of Assist devices and Biotelemetry
4. Understand the principles of Medical imaging
5. Identify modern instruments used in Medical field

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	2	1											2	2	
CO3	2	2	1		2								2	2	
CO4	2	2	3	2	2								2	2	
CO5	2	3	2	2	2								2	2	

ONE CREDIT COURSES

22EIOCSCN	MATLAB PROGRAMMING	L	T	P	C
		1	-	-	1

Implementations using an array. The fundamental concepts of MATLAB. MATLAB basics. MATLAB Interactive Sessions

Menus and the Toolbar -MATLAB as a calculator. Input and Output, M-files, Mat files, MATLAB diary.

MATLAB vector/matrix functions and operations. MATLAB plotting functions. MATLAB branching statements. MATLAB iterative statements.

MATLAB functions. Program design, MATLAB profiling and code optimization, Recursion. Searching and sorting in MATLAB. Advanced MATLAB features. complex numbers, sparse arrays, cell arrays, structure arrays.

Introduction to Simulink - Linear State-Variable Models -Piecewise-Linear Models – Transfer Function Models- Nonlinear State-Variable Models – Subsystems- - Simulation of a Nonlinear system.

REFERENCES

1. C. F. Van Loan and K.–Y. D. Fan, “Insight Through Computing: A MATLAB Introduction to Computational Science and Engineering”, SIAM Publication, 2009.
2. Holly Moore, “MATLAB for Engineers”, Pearson, 2016.

COURSE OUTCOMES

1. Understand the fundamental concepts of MATLAB.
2. Understand the principle of M-files and Mat files.
3. Learn the principle of MATLAB functions and operations.
4. Understand the principles of arrays.
5. Learn the principle of Simulink and develop the models using Simulink.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2								2		
CO2	2				2								2		
CO3	3		2		2								2		
CO4	2	3	2										2	2	
CO5	2	2	2										2	2	

22EIOCSCN	PROGRAMMING USING LINUX	L	T	P	C
		1	-	-	1

Introduction Linux introduction and file system–Basic features, advantages, installing requirement, basic architecture of UNIX/Linux system, Kernel, Shell.

Commands for Files and Directories Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, disk related commands, checking disk free spaces, Essential linux commands.

Processes in linux –process fundamentals, connecting processes with pipes, Redirecting input output, manual help, Background processing, managing multiple processes, changing process priority, scheduling of processes , batch commands, kill, ps, who, sleep, Printing commands, grep, fgrep, find, sort, cal, banner, touch, file, file related commands–ws, sat, cut, grep, dd, etc.

Shell programming: Shell programming basic, various types of shell, shell programming in bash, conditional and looping statements, case statements.

Parameter passing and arguments, shell variables, shell keywords, creating simple shell programs.

REFERENCES

1. Richard Petersen, “Linux: The Complete Reference”, Sixth Edition, 2008
2. http://www.linux.org/lessons/beginner/

COURSE OUTCOMES

1. Understand the fundamentals of Linux.
2. Understand the principle of Linux commands for files and directories.
3. Learn the concept of Processes in Linux.
4. Understand the principles of Shell programming.
5. Learn the principle of creating simple shell programs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1				2								2		
CO2	3				2								2		
CO3	2				2								2		
CO4	2	2			2								2		
CO5	2				2								2		

22EIOCSCN	PC HARDWARE	L	T	P	C
		1	-	-	1

PC Hardware BIOS settings-Motherboard Components– RAM– Expansion Cards– Storage Devices– The CPU– Interfaces– Computer Power– Custom Computer Components– Display Devices– Connector Types– Computer Peripherals.

Networking Network Connectors– Network Cabling– TCP/IP– Common Network Ports– Wireless Networking Standards– Installing a Wireless Router– Internet Connection Types– Network Types– Common Network Devices– Networking Tools.

Operating Systems Microsoft Operating Systems– Installing Windows– The Windows Command Line– Operating System Tools– The Windows Control Panel– Configuring Windows Networking– Windows Preventive Maintenance– Windows Security– Client-Side Virtualization

Laptops, Printers and Mobile Devices Laptop – Hardware, Displays; Printers-Installing and maintenance; Mobile devices Mobile Operating Systems

Network Connectivity -Securing Mobile Devices-Mobile Device Synchronization

REFERENCE

1. James K.L., “Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance”, PHI Publications, 2015.

COURSE OUTCOMES

1. Understand the fundamentals of PC hardware.
2. Understand the fundamentals of network connectors and networking tools.
3. Learn the concept of Microsoft operating systems.
4. Understand the fundamentals of Laptops, printers and their installations.
5. Learn the principle of network connectivity.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2		2								2		
CO2	2		2		2								2		
CO3	3	2	2		2								2		
CO4	3	3	2		2								2		
CO5	3	2	3		3								2		

22EIOCSCN	PRACTICAL APPROACH OF PROBLEM-SOLVING TECHNIQUES	L	T	P	C
		1	-	-	1

Software Engineer Skills – Problem – Solving a Problem: Understand the Problem, Formulate a Model, Develop an Algorithm, Write a Program, Test a Program, Evaluate the Solution.

Problem Classification – Logic – Importance of Logic in Problem Solving Types of Logic.

Programming life cycle phases – problem solving – implementation – maintenance – pseudo code representation – flow charts - RAPTOR- algorithms – algorithmic efficiency – complexity of algorithms – Testing.

Arguments to main - Environment variables - Library functions getenv, putenv and the global variable environ – Recursion - Functions with a variable number of arguments.

The library function system - The library macro assert -The library function perror and global variable errno - The atexit function - qsort, bsearch – Reallocation - Pointer to structures.

REFERENCES

1. Dormey R G. How to Solve it by Computers, PHI 2005
2. Infosys Campus Connect Foundation Programme - Problem Solving Techniques
3. http://mitpress.mit.edu/sicp/full-text/book/book-Z-H-4.html
4. Byron S. Gottfried: Theory and Problems of Programming with C Language, Schaum Series, Tata Mcgraw Hill, 2015

COURSE OUTCOMES

1. Understand the fundamentals of problem-solving techniques.
2. Understand the principle of importance of logic in problem solving.
3. Learn the concept of programming life cycle phases.
4. Understand the fundamentals of arguments.
5. Learn the concept of library function system.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	3	3	2										2		
CO3	3	2	2										2		
CO4	2	3	2		2								2		
CO5	2	2	2		2								2		

22EIOCSCN	BASICS OF LABVIEW	L	T	P	C
		1	-	-	1

Data and Data Types in general programming- LabVIEW Basics: Front Panel, Block Diagram, Icon and Connector, control, function and Tools Palette- Front Panel controls subVI.

Data Flow programming, Parallelism- Block Diagram functions: Numeric, String, Boolean, Comparison.

Structure: For, While, Event Structure, Flat and Sequence Structure, Timing functions.

Array and Cluster- Charts and Graphs- Property Node and Invoke Node

File IO Synchronization-Introduction to DAQ.

REFERENCES

1. Gary W Johnson, Richard Jennings, 'LabVIEW Graphical Programming' Fourth Edition, McGraw Hill, 2006.
2. Robert H Bishop. 'Learning with LabVIEW 2009' Pearson Education, 2010.

COURSE OUTCOMES

1. Understand the fundamentals of LabVIEW basics.
2. Understand the principle of data flow programming.
3. Learn the concept of structure and functions.
4. Understand the fundamentals of array and cluster.
5. Learn the concept of DAQ.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2								2		
CO2	2	1	3		2								2		
CO3	2	1	2		2								2		
CO4	2	3	2		2								2	2	
CO5	2	2	2		3								2	3	

22EIOCSCN	ELECTRONIC SYSTEM DESIGN	L	T	P	C
		1	-	-	1

Introduction to multisim software and basic electronic system design, Design of an Instrumentation Amplifier, Design of Voltage Regulator, Design of Flashing LEDs, Design of simple alarm using Multisim.

Design of opamp filters - low pass and high pass, Frequency Response of the Basic Op Amp Circuit using Multisim, Design of automatic light switch circuit using multisim.

Design of logic gates using transistor, design of sequence detector.

Digital display using asynchronous counter, Design of water level indicator.

Process control timer, 4 way traffic light controller, Design of simple UPS.

REFERENCES

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, Pearson Education / PHI, 2007.
2. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
3. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 6 th Edition, TMH, 2003.
4. Ranakant.A.Gayakward, OPAMP and Linear Integrated Circuits, Fourth Edition,Pearson Education, 2011.

COURSE OUTCOMES

1. Understand the fundamentals multisim software.
2. Learn the design of filters using opamp.
3. Learn the concept of designing logic gates.
4. Understand the fundamentals of designing digital display and water level indicator.
5. Learn the concept of simple UPS.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			2								2	1	
CO2	2	2	3		2								2	2	
CO3	3	2	3		2								2	3	
CO4	2	3	2		2								2	2	
CO5	2	2	2		2								2	2	

22EIOCSCN	PROGRAMMING WITH PLC AND HMI	L	T	P	C
		1	-	-	1

Introduction - Concept of relays, contactors and relay logic - Programmable Logic Circuit - PLC architecture- I/O modules.

Basic PLC programming instructions- Concept of inter locks and sequential logic. Programming using PLC - PLC configuration and programming using TIA V11. Simple programs using PLC.

Applications of PLC - Timer and counter instructions. Math and program control instructions.

Real time application based programs.

Introduction to HMI - Integration PLC and HMI - HMI programming

REFERENCES

1. Frank D.Petruzella, 'Programmable Logic Controllers', Fourth edition, Tata McGraw Hill, 2010
2. John W. Webb, Ronald A. Reis 'Programmable Logic Controllers and Applications', PHI Learning,Fifth Edition, 2009.

COURSE OUTCOMES

1. Understand the fundamentals of PLC.
2. Understand the importance of PLC programming instructions.
3. Learn the concept of timer and counter instructions.
4. Understand the concept of developing simple and application-based programs.
5. Learn the fundamentals of HMI and HMI programming.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2								2	**2**	**1**
CO2	2	2	3		2								2	2	3
CO3	2	3	2		2								2	2	3
CO4	2	3	2		3								2	2	2
CO5	2	2	2		3								2	2	**3**

22EIOCSCN	INSTRUMENTATION SYSTEM	L	T	P	C
		1	-	-	1

Process Control and Process Safety Elements-Overview of Process control, Identification of elements, Control loop, Control System evaluation, P and I Symbols and diagrams.

Process Safety Incidents – Process Involvement – Reporting Thresholds – Location – Actual release – Industry Process Safety Metrics.

Overview of OPAMP: Differential Instrumentation Amplifier – (4-20) ma Current converter – Signal Conditioning for temperature sensors.

Position sensor, Strain Sensor and Photo detectors. V/F converter, ADC and DAC. Current to Pressure Converter.

Switching devices - electrical control solenoid valves, Relays – Hydraulic / Pneumatic Actuators - Fluid Valves – Pneumatic valve - Director control valve – 3/2 way valve – 5/2 way valve – Shuttle valve – check valve.

REFERENCES

1. Curtis D. Johnson, “Process Control Instrumentation Technology”, PHI Learning PVT Ltd., New Delhi, 2012.
2. D. Patranabis, “Instrumentation and Control”, PHI Learning PVT Ltd., New Delhi, 2011.

COURSE OUTCOMES

1. Understand the fundamentals of Process Control and Process Safety Elements.
2. Understand the importance of process safety incidents.
3. Learn the design of signal conditioning circuit for temperature sensors using operational amplifier.
4. Understand the fundamentals of different sensors and converters.
5. Learn the fundamentals of various types of valves.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2								2		
CO2	2	3	2		2								2	3	
CO3	3	3	2										2	2	
CO4	2	3	2		2								2	2	2
CO5	2	3	2		2								2	2	2

22EIOCSCN	SENSORS AND SYSTEMS	L	T	P	C
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HYDRAULICS Basics of Hydraulics - Components of hydraulics - Types of valves – DCVs - operations - hydraulic Circuits – Electro hydraulics - Solenoids - Relays

Electrical logic circuits - Applications of electro hydraulics - Practices on electro hydraulic circuits.

PNEUMATICS Basics of Pneumatics - Components of Pneumatics - Types of valves - DCVs - operations - Pneumatic circuits – Electro pneumatics - Electrical Logic circuit – Relay ladder logic - Applications of electro pneumatics - Practices on electro pneumatic circuits.

SENSORICS Introduction to sensorics - Closed loop system - Types of Proximity sensors - construction - principle of operation - Applications proximity sensors - electrical connections - Practices on all types of proximity sensors.

MECHATRONICS Introduction to Mechatronics system – over view of Automation System – Types of Automation– role of sensors in automation system – Electrical drives – interfacing of PLC – Case study of modular Mechatronics System (mMs) – Demonstration of mMs - Troubleshooting of mMs.

COURSE OUTCOMES

1. Understand the fundamentals of hydraulics and various components of hydraulics.
2. Understand the importance of electrical logic circuits.
3. Learn the concept of PNEUMATICS
4. Understand the fundamentals of SENSORICS.
5. Learn the fundamentals of MECHATRONICS.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2	2	
CO2	2	2			2								2	2	
CO3	3	2			2								2	2	
CO4	2	2	2		2								2	2	
CO5	2	2	2		2								2	2	

VALUE ADDED COURSES

22EIVAC01	INDUSTRIAL AUTOMATION	L	T	P
		1	0	1

UNIT I
INTRODUCTION TO AUTOMATION
Automation overview – requirement of automation systems – architecture of industrial automation system – Levels of Automation-basic components of an automated system – Programmable Automation Controllers (PAC).

UNIT II
INTRODUCTION TO DATA ACQUISITION AND INDUSTRIAL CONTROL
Sampling fundamentals, ADC, DAC, Data acquisition interface requirements.Sensors for temperature, pressure, flow and level measurements, smart sensors, Industrial Control Systems, Continuous Verses Discrete Control, Computer Based Industrial Process Control.

UNIT III
PROGRAMMABLE LOGIC CONTROLLERS
PLC Hardware – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries.

UNIT IV
INTRODUCTION TO SUPERVISORY CONTROL AND DATA ACQUISITIONS, DISTRIBUTED CONTROL SYSTEM
Computer networks and communication in DCS, different BUS configurations used for industrial automation – GPIB, HART and PROFIBUS. SCADA / HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software

UNIT V
HANDS ON TRAINING
Simple experiments on sensors, Actuators, Data acquisition and computer control, PLCs, HMI and SCADA.

TEXT BOOKS
1. S.Mukhopadhyay, S.Sen and A.K. Deb, Industrial Instrumentation Control and Automation, Jaico Publishing House, 2013.
2. Patranabis, Principles of Industrial Instrumentation, McGraw Hill,

REFERENCES
1. R.Krishnan, Electric Motor Drives, Modelling, Analysis and Control, Prentice Hall India, 2002.
2. Biswanath Paul, Industrial Electronics and Control Including Programmable Logic Controller
3. Krishna Kant, “Computer Based Industrial Control” Second edition, Prentice Hall of India, New Delhi,2010, PHI,2014.
4. Lukcas, Distributed Control Systems, Van Nostrand Reinhold Co.,1986.

5. John W Webb, Programmable Logic Controllers: Principles and Applications Pearson, 2015.

22EIVAC02	DATA ANALYSIS, VISUALIZATION AND SCIENTIFIC COMPUTATION WITH MATLAB	L	T	P
		2	0	2

UNIT I
INTRODUCTION
Introduction to MATLAB-Getting into MATLAB- Constants (Built-in Constants) and Variables-Assignment Statements-Operators and Expressions-Operator precedence-Vectors and Matrices-Simple MATLAB Scripts-User defined functions-passing arguments to functions.

UNIT II
DATA IMPORT-EXPORT UTILITIES
Creating random data-Importing and Exporting Data -Importing Data into the Workspace **-**Exporting Data from the Workspace -Importing data to Excel files-Exporting Data from the Excel files- Using MAT-Files for Variables-Saving and loading MATLAB variables-Problems with importing formatted data-MATLAB commands to import audio, image and video formats.

UNIT III
STATISTICAL FUNCTIONS
MATLAB Statistical Functions-minimum-maximum-sum-product-mean-standard deviation-mode-median-Built in functions for set operations like Union, Intersection, Unique set, set difference and set exclusive OR- Sorting operation - sorting elements within a vector - sorting rows within a matrix by values in a column- variance of a vector - covariance of a matrix- correlation coefficient function.

UNIT IV
GRAPHICS AND VISULAIZATION
Basic plotting function- subplots- Customizing Plots- Logarithmic plots- Histograms and Barchart-3D plots functions- Creating mesh and surface plots- contour functions- other 3D plot functions- Display images- Printing graphics- Introduction to Graphical User Interface(GUIs).

UNIT V
DATA ANALUSIS METHODS
Matrix solutions to systems of Linear Algebraic Equation- Curve Fitting- Interpolation and Extrapolation - Regression - Finding roots of polynomials- Visualizing solution of Ordinary Differential Equations (ODEs).

REFERENCES

1. Stormy Attaway, Matlab: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann; 4th edition, 2016.
2. Brian Hahn and Dan Valentine, Essential MATLAB for Engineers and Scientists, Academic Press; 6th edition, 2016.
3. Stormy Attaway, Matlab: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann, 5th edition, 2018.

4. C. Henry Edwards, David E.Penney, David Calyis, Differential Equations: Computing and Modeling (5th Edition) (Edwards, Penney & Calvis, Differential Equations: Computing and Modeling Series) Pearson, 5th Edition, 2014.

22EIVAC03	ARDUINO PROGRAMMING TO BUILD REAL WORLD APPLICATIONS	L	T	P
		2	0	2

UNIT I

INTRODUCTION

Introduction and Familiarization - Course Introduction - Hardware Overview - Download and Install the Arduino IDE - Arduino IDE and Sketch Overview - Understanding Arduino data types, Variables and constants, Arrays, Operators, Control Statements

UNIT II

ARDUINO FUNCTIONS AND COMMUNICATION

Pins Configured as INPUT- Pull-up Resistors-Pins Configured as OUTPUT- pinMode Function -digitalWrite Function -digitalRead -analogRead function -Arduino Interrupts-delay function-delay functions-delayMicroseconds function -millis function -micros function- and Serial Port Communication.

UNIT III

ARDUINO DISPLAYS

Working with Serial Monitor -Line graph via serial monitor -Interfacing a 8 bit LCD to Arduino -Fixed one line static message display- Running message display-Using the LCD Library of Arduino

UNIT IV

SENSORS AND ACTUATORS

Connecting and work with different sensors, such as Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal sensor, Soil moisture sensor, Passive Infrared (PIR) sensor, color sensor, Flame/Fire sensor, Touch sensor, Accelerometer sensor, Pulse/Heart beat sensor, Alcohol/gas sensor to ARDUINO Board- Reading various sensor data on serial monitor and LCD Display- Functioning of actuator.

UNIT V

SIMPLE PROJECTS

Simple Projects: Automated Plant Watering System - Smart Dustbin-IR Sensor-based Automatic Gate Opener-Fire Alarm Circuit - Arduino Traffic Light Simulator - Door Alarm using an Ultrasonic Sensor - Pulse Rate (BPM) Monitor using Arduino & Pulse Sensor.

REFERENCES

1. Simon Monk, Arduino: Getting Started with Sketches, Second Edition (Tab), Kindle Edition, McGraw Hill Publishing House, 2016.

2. Ryan Turner, Arduino Programming: 2 books in 1 - The Ultimate Beginner's & Intermediate Guide to Learn Arduino Programming Step by Step Paperback, Nelly B.L. International Consulting Ltd, 2019.
3. James Arthur, Arduino: The complete guide to Arduino for beginners, including projects, tips, tricks, and programming, Ingram Publishing, 2020.
4. Daniel Geron, Arduino Programming: The Ultimate Guide for Absolute Beginners with Steps to Learn Arduino Programming and The Fundamental Electronic Concepts, Tiger Gain Ltd, 2021.

22EIVAC04	BASICS OF ROBOTICS	L	T	P
		2	0	2

UNIT I
AUTOMATION
Mechanization and Automation - - Reasons for automation - Types of Automation: Fixed, Flexible and Programmable Automation - Automation and Robotics.

UNIT II
FUNDAMENTALS OF ROBOTS
Definition - Robot Anatomy - Robot configuration: Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration - Degree of freedom - Work volume - Dynamic performance: Speed of response, Accuracy, Repeatability-Robot Drive System: Hydraulic, Electric and Pneumatic.

UNIT III
INTRODUCTION TO ROBOT END EFFECTORS, SENSORS AND CONTROL SYSTEM
End Effectors: Types: Mechanical grippers, Magnetic grippers, Vacuum cups- Tools as end effectors
Design of Sensors: Transducers and Sensors - Sensors in Robotics: Tactile, Proximity and Range Sensors, sensor-based systems - Robot Vision System.
Control System: Lead-through Programming, Walk-through Programming, Use of Teach pendants.

UNIT IV
LAB WORK
Experiments on various sensors and drive system in connection with Robotic system.

UNIT V
ROBOT PROGRAMMING AND APPLICATIONS
Robot Programming: Textural Programming: Common languages/Software used-Robot program as a path in space- Experiments on Lead-through Programming, Walk-through Programming, Use of Teach pendants.

TEXT BOOKS
1. Groover, M.P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice-Hall of India Private Limited, New Delhi, 2007.
2. Groover, M.P., Weiss, M., Nagel, R.N., Odrey, N.G., Industrial Robots: Technology, Programming and Applications, McGraw-Hill Book Company, 2012

REFERENCE BOOKS
1. Deb, “Robotics Technology and Flexible Automation”, Tata McGraw Hill, 1994.
2. Saeed B. Niku, An Introduction to Robotics- Analysis, Systems, Applications, Second Edition, John Wiley & Sons Inc., 2010.
3. Wesley, E. Sryda, “Industrial Robots: Computer interfacing and Control” PHI, 1985.
4. Yoran Koren, Robotics for Engineers, McGraw Hill, 1980.

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B.E. Electronics and Instrumentation

ANNAMALAI UNIVERSITY PRESS : 2022 – 2023