1. Condition for Admission

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

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

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

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

2. Branches of Study in B.E.

<table>
<thead>
<tr>
<th>BRANCH I</th>
<th>Chemical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRANCH II</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>BRANCH III</td>
<td>Civil and Structural Engineering</td>
</tr>
<tr>
<td>BRANCH IV</td>
<td>Computer Science and Engineering</td>
</tr>
<tr>
<td>BRANCH V</td>
<td>Electrical and Electronics Engineering</td>
</tr>
<tr>
<td>BRANCH VI</td>
<td>Electronics and Communication Engineering</td>
</tr>
<tr>
<td>BRANCH VII</td>
<td>Electronics and Instrumentation Engineering</td>
</tr>
<tr>
<td>BRANCH VIII</td>
<td>Information Technology</td>
</tr>
<tr>
<td>BRANCH IX</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>BRANCH X</td>
<td>Mechanical Engineering (Manufacturing)</td>
</tr>
</tbody>
</table>
3. Courses of Study and Scheme of Examinations

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

4. Choice Based Credit System (CBCS)

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

5. Eligibility for the Degree

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

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

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

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

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

(or)

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

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

5.3. B.E (Honours) Degree

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

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

Annexure-II

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

6. Assignment of Credits for Courses

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

7. Duration of the Programme

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

8. Registration for Courses

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

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

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

8.1. Slow Learners

The slow learners may be allowed to withdraw certain courses with the approval by the Head of the Department and those courses may be completed by them in the fifth year of 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. Advance Learners

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

9. Mandatory Internship (Industrial Training)

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

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

The student must get involved in any of the following Inter/ Intra Institutional Activities for 4 weeks duration:

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

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

(iii) Participation in conferences/ workshops/ competitions.

(iv) Learning at Departmental Lab/ Institutional workshop.

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


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

The student may choose any of the following Internship / Innovation / Entrepreneurship related activities for 4 weeks duration:

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

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

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

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

11. Mandatory Induction program

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

12. Electives

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

12.1. Professional Elective courses

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

12.2. Open Elective courses

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

12.3. MOOC (SWAYAM) Courses

Further, the student can be permitted to earn not more than 20% of his total credits (that is 32 credits) by studying the Massive Open Online Courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent to the
professional elective and/or open elective courses. Thus the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

12.4. Value added courses (Inter Faculty Electives)

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

12.5. One Credit Courses

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

12.5.1. Industry Expert

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

12.5.2. NSQF Courses

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

13. Assessment

13.1. Theory Courses

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

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

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

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

13.3. Project Work

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

13.4. Industrial Internship

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

14. Substitute Assessment

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

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

15. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.
16. Class Committee
For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator. The composition of the class committee during first and second semesters will be as follows:

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

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

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

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

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

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

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

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

If a student wishes to apply for break of study, the student shall apply to the
Dean in advance, in any case, not later than the last date of the first assessment period.

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

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

19. Procedure for withdrawing from the Examinations

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

20. Passing and declaration of examination results

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

<table>
<thead>
<tr>
<th>Marks Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90 to 100 marks</td>
<td>Grade 'S'</td>
</tr>
<tr>
<td>80 to 89 marks</td>
<td>Grade 'A'</td>
</tr>
<tr>
<td>70 to 79 marks</td>
<td>Grade 'B'</td>
</tr>
<tr>
<td>60 to 69 marks</td>
<td>Grade 'C'</td>
</tr>
<tr>
<td>55 to 59 marks</td>
<td>Grade 'D'</td>
</tr>
<tr>
<td>50 to 54 marks</td>
<td>Grade 'E'</td>
</tr>
<tr>
<td>Less than 50 marks</td>
<td>Grade 'RA'</td>
</tr>
<tr>
<td>Withdrawn from the examination</td>
<td>Grade 'W'</td>
</tr>
</tbody>
</table>

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

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

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

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

A student who obtains letter grade W in the mark sheet must reappear for the examination of the courses.
The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

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

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

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

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

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

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

21. Awarding Degree

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

21.1. Honours Degree
To obtain Honours Degree a student must earn a minimum of 186 credits within four years (144 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 CGPA of 8.25 or above.

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

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

21.4. Second Class
For Second Class, the student must earn a minimum of 166 credits within seven years (124 credits within six years for lateral entry students) from the time of admission.
21.5. B.E Degree with Minor Engineering

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

22. Ranking of Candidates

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

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

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

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

23. Transitory Regulations

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

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

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

VISION

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

MISSION

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

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

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

M4 To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one’s career
**PROGRAMME EDUCATIONAL OBJECTIVES (PEO)**

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

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

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

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

**PROGRAMME OUTCOMES (PO)**

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

<table>
<thead>
<tr>
<th>PO</th>
<th><strong>Integration of knowledge</strong></th>
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<tbody>
<tr>
<td></td>
<td>Apply the knowledge of mathematics, science and engineering fundamentals in analog and digital electronic systems, instrumentation and control engineering</td>
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<tr>
<th>PO</th>
<th><strong>Problem analysis</strong></th>
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<tbody>
<tr>
<td></td>
<td>Formulate, solve and analyze complex problems in electrical circuits, electronic systems, instrumentation and control engineering</td>
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<tr>
<th>PO</th>
<th><strong>Design and development of solutions</strong></th>
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<td></td>
<td>Apply the acquired knowledge for designing systems/processes to address the specific needs and to pull off solution, with appropriate consideration for health, safety, and environmental issues</td>
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<tr>
<th>PO</th>
<th><strong>Use of modern tools and techniques</strong></th>
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<tbody>
<tr>
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<td>Select and apply appropriate modern engineering tools including prediction and modelling software packages, Distributed Control System, Programmable Controllers and advanced processors.</td>
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<tr>
<th>PO</th>
<th><strong>Collaborative and multidisciplinary approach</strong></th>
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<td>Gain exposure to attain knowledge and understand inter disciplinary and multidisciplinary engineering sciences</td>
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<tr>
<th>PO</th>
<th><strong>Ethical practices</strong></th>
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<td>Acquire professional and intellectual integrity, professional code of conduct, ethics on professional practices, understanding responsibilities and norms for sustainable development of society.</td>
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<th>PO</th>
<th><strong>Communication skills</strong></th>
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<td>Interact with the engineering community and with society at large, regarding intricate engineering activities on technical perspectives and emerge as an efficient motivator.</td>
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<tr>
<th>PO</th>
<th><strong>Project management</strong></th>
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<td>Understand the engineering and management concepts and demonstrate the knowledge as an entrepreneur or member/leader in teams and multidisciplinary tasks in their profession</td>
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</table>
Lifelong learning
Appreciate the need for self preparation and life-long learning independently in the broadest context of technological challenges.

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.

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.

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

Mapping PO with PEO

<table>
<thead>
<tr>
<th>PEO1</th>
<th>PEO2</th>
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DETAILS OF COURSE CODE

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**Total Credits** 17.5

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**Total Credits** 20.5

**SEMESTER III**

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* For the Lateral entry students total credit for III Semester is 23.5 as they are exempted from internship during summer vacation of II semester.

**Total Credits** 27.5
### SEMESTER IV

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**Total Credits:** 21.5

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.

### SEMESTER V

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**Total Credits:** 26.5

### SEMESTER VI

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**Total Credits:** 21.0

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.
### SEMESTER VII

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**Total Credits** 19.5

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### LIST OF PROFESSIONAL ELECTIVES

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Course Objectives

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

Unit–I : Partial Differential Equations


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**


**Unit–V : Z – Transform and difference equations**


**TEXT BOOKS**


**REFERENCES**


**COURSE OUTCOMES**

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

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

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**COURSE OBJECTIVES**

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

**Unit–I**

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

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

Unit–II

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

Unit–III

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

Unit–IV

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


Unit–V

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

2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net

REFERENCES

2. Clark R.S., Marine Pollution, Claderson Press Oxford
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001,
6. Down to Earth, Centre for Science and Environment
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural
10. History Society, Bombay
15. Mhaskar A.K., Matter Hazardous, Techno-Science Publication
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.

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COURSE OBJECTIVES

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

Unit-I: Basics & Statics Of Particles


Unit-II: Equilibrium Of Rigid Bodies

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

Unit-III: Properties Of Surfaces And Solids

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

**Unit-IV: Dynamics Of Particles**


**Unit-V: Friction and Elements of Rigid Body Dynamics**

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

**TEXT BOOKS**


**REFERENCES**

6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
COURSE OUTCOMES

At the end, Students can able to

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

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COURSE OBJECTIVES

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

Unit – I

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

Unit – II

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

Unit – III

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


Unit – V

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

TEXT BOOKS

REFERENCES

COURSE OUTCOMES

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

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

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COURSE OBJECTIVES

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

Unit-I : Network Theorems


Unit-II : Solution of First and Second order networks

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

Unit-III : Sinusoidal steady state analysis

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

Unit-IV : Electrical Circuit Analysis Using Laplace Transforms


Unit-V : Two Port Network and Network Functions

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

TEXT BOOKS


REFERENCES


**COURSE OUTCOMES**

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

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

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**COURSE OBJECTIVES**

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

**Unit-I: Diode circuits**

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

**Unit-II: BJT circuits**

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

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

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

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

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

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

TEXT BOOKS

REFERENCES

COURSE OUTCOMES

At the end of this course, students will be able to
1. Understand the characteristics of transistors.(Unit II)
2. Design and analyse various rectifier and amplifier circuits. (Unit I)
3. Understand the fundamental concepts of MOSFETs and their applications for analog electronics circuits. (Unit III)
4. Understand the functioning of OP-AMP. (Unit IV)
5. Understand the design OP-AMP based circuits. (Unit V)
Mapping of COs with POs

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18EISP307 FLUID MECHANICS & HYDRAULICS MACHINERY LAB

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COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

Make the students understand

1. After completion of this course, a student will be able to:
2. Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits
3. Develop Characteristics of pumps and turbines.
COURSE OBJECTIVES
1. To study & verify the circuit theorems practically
2. To understand the significance of the circuit theorems and their applications
3. To understand the significance of resonance conditions in series and parallel circuits

LIST OF EXPERIMENTS
1. Analysis of DC resistive circuits and verification of Kirchhoff’s Laws.
2. Verification of Maximum power transfer theorem.
   a. Verification of Thevenin’s theorem.
   b. Verification of Norton’s Theorem.
   c. Verification of Superposition Theorem.
   d. Verification of Tellegen’s Theorem.
4. Analysis of DC resistive circuit using EWB software. [Study of ORCAD software (Application to circuit analysis).]
5. Experimental determination of time constant of series R-C electric circuits
7. Design of low pass and high pass passive filters.
8. 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 three phase circuits by two-watt meter method.

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

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COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

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

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

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18EICP309 ANALOG ELECTRONICS LAB

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COURSE OBJECTIVES

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

Unit–I : Probability and Random Variables

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

Unit–II : Random Processes


Unit–III : Test of Significance

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

Unit–IV : Interpolation

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

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

Numerical integration: Trapezoidal rule, Simpson’s one-third and three-eighth rule.

Unit–V :


TEXT BOOKS

REFERENCES

COURSE OUTCOMES
At the end of the course, the students would
1. Acquire skills in handling situations to solve problems for engineers using numerical methods.
2. Understand random variables and random processes
3. Understand numerical differentiation and integration
4. Give numerical solution for algebraic and transcendental equations.
5. Give numerical solution for ordinary differential equation.

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

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

Energy measurement - Induction type energy meter, principle, construction, errors and compensation. Calibration of wattmeters and energymeters.
Potentiometers: AC potentiometers - Drysdale potentiometer, Gall potentiometer, DC potentiometers - Leeds and Northrup potentiometer, Brooks deflection potentiometer

**Unit–II AC and DC bridges**

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

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

**Unit–III DC Machines**

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

**Unit–IV Induction Machines**


**Unit–V Magnetic circuit**

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

**TEXT BOOKS**


**REFERENCES**

COURSE OUTCOMES

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

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COURSE OBJECTIVES

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

Unit-I : Introduction to Control Problem

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

Unit-II : Time Response Analysis

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

Unit-III : Stability Analysis

Unit-IV : Frequency Response Analysis

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

Unit-V : State Variable Analysis

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

TEXT BOOKS

REFERENCES

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

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COURSE OBJECTIVES

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

Unit-I: Fundamentals of Digital Systems and logic families

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

Unit II: Combinational Digital Circuits

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

Unit III: Sequential circuits and systems

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

Unit IV: A/D and D/A Converters

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

Unit V: Semiconductor memories and Programmable logic devices.

- Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge decoupled
device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

**TEXT BOOKS**

**REFERENCES**

**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)

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


Component measuring instruments

Q-meter - vector impedance meter - Power meter.

Signal sources and Wave analyzers

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

Unit–II : Digital Measurements

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

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

Unit–III : Oscilloscope and Display devices


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

Unit–IV : Recorders and 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.

Unit–V : Computer Controlled Test Systems and Virtual Instrumentation


TEXT BOOKS

REFERENCES

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

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18EIPC406 TRANSUCERS AND MEASUREMENT SYSTEMS

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

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

Unit–II : Performance Characteristics

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

Unit–III : Resistance Transducers

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

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

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

Unit–IV : Capacitance and Inductance Transducers

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

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

Unit–V : Other Types of Transducers

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

TEXT BOOKS

2. A.K. Sawhney, A course in Electrical and Electronics measurement and instrumentation, Dhanpatrai and sons, 1996.

REFERENCES


**COURSE OUTCOMES**

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

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

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

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

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

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

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**COURSE OBJECTIVES**

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

**LIST OF EXPERIMENTS**

1. Determination of transfer function of a DC Servomotor and its speed control.
2. Solving Control Engineering problems using MATLAB software.
3. Study of DC Position control system.
4. Design and implementation of a Phase Lead Compensator using MATLAB software.
5. Identification of a given system using frequency response characteristics.
6. Characteristics of Sample and Hold circuit.
7. Simulation of a Sampled data control system.
10. Time response analysis of a Second order type-0 and type-1 system using Process Control Simulator.

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

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

LIST OF EXPERIMENTS
1. Verification of logic gates using integrated circuits.
2. Simplification of logic expressions using Karnaugh map techniques.
3. Implementation of half adder and full adder circuits using logic gates.
4. Design and Realization of one bit, two bit and magnitude comparators.
5. Design and verification of parity generator circuits.
7. Design and simulation of 3 bit synchronous counter using EWB software.
8. Implementation of Digital to Analog converter.
9. Verification of Multiplexer/Demultiplexer.
10. Implementation of i) priority encoders and ii) LED decoder driver circuit.
COURSE OUTCOMES
At the end of the course the students will be able to
1. Test and understand the logic gates using their truth tables which is very useful in the design of Integrated Circuits.
2. Simplify the complex logic function into simplest one so that it is possible to reduce the size of the circuit.
3. Design of various electronic circuits using the fundamental concepts in digital electronic systems for various industrial applications.
4. Simulate various electronic circuits using Electronic Work Bench Software without the use of physical electronic components so that it is possible to reduce the time, energy and cost.
5. Troubleshoot the malfunctioning of electronic circuits and to identify the compatibility of system components in the design of Integrated Circuit.

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

LIST OF EXPERIMENTS
2. Characteristics of Synchro and application of Synchro as error detector.
3. Simulation of signal conditioning circuit for LVDT.
5. Characteristics and Transfer function of RTD and Thermocouple.
6. Design, construction and testing of a signal conditioning circuit for temperature Measurement using RTD.
7. Simulation of Voltage to Current converter and its practical implementation.
8. Simulation of Current to Voltage converter and its practical implementation.
10. Design and testing of signal conditioning circuits using EWB software.
COURSE OUTCOMES

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

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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**


**Unit–V : Level Measurement**


**TEXT BOOKS**


**REFERENCES**


**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)

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COURSE OBJECTIVES

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

Unit-I : Introduction to Signals and Systems

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

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

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


Unit-IV : Analysis of Discrete time signals and systems

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

Unit-V : Sampling and Reconstruction


TEXT BOOKS


REFERENCES


COURSE OUTCOMES

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

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

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COURSE OBJECTIVES

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

Unit–I: Mathematical Modelling of Processes


Unit–II: Controllers and Final Control Elements


Control valve – characteristics of control valves – valve positioned.

Unit–III: Optimum Controller Settings

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

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

Unit–IV: Piping and Instrumentation Diagram

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

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

Unit–V: Case Study


TEXT BOOKS


REFERENCES
5. TUTSIM Simulation Language Manual, TUTSIM Products Ltd., U.S.A.

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)

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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**


**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**


**REFERENCES**


**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 program. (Unit III)
4. Programming the on-chip peripherals of microcontroller. (Unit–IV : )
5. Understand the recent trends and make use of microprocessor and microcontroller for different applications. (Unit V)
COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

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

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

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

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

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COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

Understand the architecture of 8085.

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

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Course Objectives

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

Unit-I : Discrete-time signals and systems

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

Unit-II : Z-transform


Unit-III : Discrete Fourier Transform


Unit-IV : Design of Digital filters


Unit-V : Applications of Digital Signal Processing


TEXT BOOKS


REFERENCES

Course Outcomes

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

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

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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 microprocessor based data acquisition and implementation of PID control system.

Unit—I


Unit—II

Orifice meter - design of orifice for given flow condition - design of rotameter - design of signal conditioning circuit for RTD based temperature transmitter - design of cold junction compensation circuit for thermocouple based temperature
transmitter - zero and span adjustment in D/P transmitters and temperature transmitters.

Unit-III

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

Unit-IV

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

Unit-V

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

TEXT BOOKS


REFERENCES


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)

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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 processes.
- To learn the design and development procedure of cold junction compensation scheme using RTD.

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

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

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

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COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

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

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COURSE OBJECTIVES

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

Unit–I


Unit–II


Unit–III


Unit–IV


Unit–V


TEXT BOOKS


REFERENCES

COURSE OUTCOMES

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

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18EIPC702 COMPUTER CONTROL OF PROCESSES

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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


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**


**REFERENCES**

5. W. Bolton, Programmable Logic Controllers, Elsevier Newnes, 2006

**COURSE OUTCOMES**

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

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

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COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

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

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PROJECT WORK AND VIVA VOCE

COURSE OBJECTIVES

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

METHOD OF EVALUATION

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

COURSE OUTCOMES

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

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PE - PROFESSIONAL ELECTIVES

VIRTUAL INSTRUMENTATION & SMART SENSORS

COURSE OBJECTIVES

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

Unit-I : Introduction

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

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

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

Unit–III: Programming Techniques

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

Unit–IV: Analysis Tools and Application of VI


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


REFERENCES

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)

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COURSE OBJECTIVES

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

Unit–I

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

Unit–II

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

Unit–III


Unit–IV

X-ray Spectroscopy – X-ray spectrometer - Production of X-rays - detection of X-rays and nuclear radiations- ionization chamber – principle of counters - proportional counter, GM counter, scintillation counter - solid state detector -
gamma ray spectrometer – isotope dilution and tracer techniques for quantitative estimation and analysis.

**Unit–V**


**TEXT BOOKS**


**REFERENCES**


**COURSE OUTCOMES**

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

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**COURSE OBJECTIVES**

- To understand the physical foundations of biological systems and the various electrodes used in medical field.
- To have a detailed understanding about the various electro physiological measurements in the human body.
- To gain knowledge on the measurement of non-electrical parameter in the human body.
• To understand the basic concepts of various medical imaging techniques and their applications.
• Understand medical assisting and therapy equipments.

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

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

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

Unit IV

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

TEXT BOOKS
2. R.Anandanatarajan, Biomedical Instrumentation, PHI Learning, 2009.

REFERENCES

**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)

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**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**

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


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

REFERENCES

COURSE OUTCOMES
1. Ability to understand the function of boiler and also P&ID of thermal power plant.(Unit I)
2. Ability to understand the types of measuring equipment used in thermal power plant. (Unit–I and II)
3. Ability to identify and analyze the specific features of different types of control techniques used in Boilers. (Unit III)

4. Ability to understand the function of turbine and its lubrication method and understand the various safety methods involved in the proper functioning of thermal power plant. (Unit IV)

5. Ability to understand the function of nuclear power plant, various sensors, control loops and safety measures employed in nuclear power plant. (Unit V)

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**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**


**Unit–II : Heat Transfer and its Applications**


**Unit–III : Mass Transfer and its Applications**

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


REFERENCES


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)
COURSE OBJECTIVES

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

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

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

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

Unit–II : Dynamics of Fluid Flow

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

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

Unit–III : Flow in Open Channels

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

Non-uniform flow through open channels - specific energy and specific energy curve - critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.
Unit–IV : Impact of Jet and Turbines

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


Unit–V : Pumps

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

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

TEXT BOOKS


REFERENCES


COURSE OUTCOMES

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

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COURSE OBJECTIVE

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

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Unit-V

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

TEXT BOOKS


REFERENCES


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).

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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

Unit-IV : FPGA

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
2. Ian Grout, Digital Systems Design with FPGAs and CPLDs, Newnes imprint of Elsevier Ltd., 2010.

REFERENCE BOOKS

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).

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18EIPESCN REAL TIME OPERATING SYSTEMS

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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


Unit–II : Overview of RTOS


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

REFERENCES

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


Unit–II : Introduction to network

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

Unit–III : Network protocols

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

Unit–IV : DCS

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

Unit–V : HART and Field bus


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

REFERENCE BOOKS

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

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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


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

REFERENCES

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

REFERENCES
2. Andrew sloss, Dominicsymes and chris wright, ARM system developers guide Morgan Kaufmann.

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

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

Unit I: Introduction to Embedded Systems

Unit II: PIC Microcontroller

Unit III: Embedded Programming
Embedded programming – modular and C code construction – creating and accessing data in C – C programming structures – programming elements – queues
– stacks - list and order lists - C Cross compilers – introduction RAID and KEIL – writing simple programs in embedded C.

**Unit–IV : Real Time Operating System**

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

**Unit–V :System Design Techniques**


**TEXT BOOKS**


**REFERENCES**


**COURSE OUTCOMES**

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

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COURSE OBJECTIVES

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

Unit I: Semiconductor Power Devices

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

Unit II: Phase Controlled Rectifiers


Unit III: Single Phase Inverter

Series, Parallel & Bridge inverters - Current source inverter.

DC choppers

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

Unit IV: DC Motor Control

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

Unit V: AC Motor Control


TEXT BOOKS


REFERENCES

2. C.N.Pauddar, Semiconductor Power Electronics (Devices and circuits), Jain Brothers, New Delhi, 1999.


**COURSE OUTCOMES**

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

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

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**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**


**Unit–II**


**Unit–III**


**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- cuts for fuzzy relations-Fuzzification -

**Unit-V**

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

**TEXT BOOKS**


**REFERENCES**


**COURSE OUTCOMES**

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

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

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**NON LINEAR CONTROL SYSTEMS**

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**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

Unit–III : Stability Analysis

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

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

REFERENCES

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)

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**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 problems.
- To study about the concepts of dynamic programming and its application.

**Unit–I : Optimal Control Problems and 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 - Pontryagin's minimum principle - state inequality constraints - minimum time problem - minimum control effort problems.

**Unit–IV : LQ Control 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

REFERENCES

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)

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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

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**


**REFERENCES**


**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)

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**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

Unit–III: Design of Structured Residuals

Unit–IV: Design of Directional Structured Residuals

Unit–V: Data Driven Methods
Principal Component Analysis – Partial Least Squares - Canonical Variate Analysis – Knowledge Based Methods.

TEXT BOOKS

REFERENCES

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)
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COURSE OBJECTIVES

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

Unit I

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

Unit II

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

Unit III

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

Unit IV


Unit V

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

TEXT BOOKS


REFERENCES


**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).

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**COURSE OBJECTIVE**

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

**Unit–I**

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

**Unit–II**

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

**Unit–III**

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

**Unit–IV**

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

**Unit–V**

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

REFERENCES

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

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

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

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

Unit–III
Level measurement: Introduction, Mechanical and electrical methods of level measurement.
Unit–IV
Flow measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters, Hot wire anemometer and ultrasonic flow meters.

Unit–V
Calibration and selection of Flow meters

TEXT BOOKS

REFERENCES

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

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COURSE OBJECTIVE
- This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.
Unit–I
Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic - Application of PLC.

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

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

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

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

TEXT BOOKS

REFERENCES

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


Unit–II


Unit–III


Unit–IV


Unit–V


TEXT BOOKS
2. Lessons from Nano electronics. A New Perspective on Transport-
3. Supriyo Datta, Purdue University, USA, 2012.

REFERENCES

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

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

Unit-I : Miniaturization of Systems
Need for miniaturization, Microsystems versus MEMS, Need for micro fabrication, smart materials, Structure and Systems, Application of smart material and Micro system. Scaling in mechanical domain, Scaling in Electrostatic domain, Scaling in thermal domain.
Unit–II : Micromachining Technology


Unit–III : Silicon Capacitive Accelerometer

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

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

Unit–IV : Modelling of Solids in Microsystems

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

Unit–V : MEMS Actuators and their Applications


TEXT BOOKS

REFERENCES

COURSE OUTCOMES
At the end of the course the students will be able to
1. The fundamentals of Micro electromechanical systems and their applications will be studied. (Unit I)
2. The fundamental concepts of MEMS Fabrication process will be gained. (Unit II)
3. The design concepts of MEMS devices will be developed. (Unit II, III & IV)
4. The Functionalities of various methods of micromachining involved in different MEMS devices will be studied. (Unit V)
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18EIOESC N  INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES  LTTPC

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Course Objectives

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

Unit-I : Oil extraction and processing

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

Unit-II : Petroleum refining

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

Unit-III : Chemicals from petroleum

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

Unit-IV : Control loops in petrochemical industry

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

Unit-V : Safety in instrumentation systems

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

TEXT BOOKS


REFERENCES

**Course Outcomes**

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

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**HONOUR ELECTIVES**

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**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**


**Unit—II: Anti-Windup Strategies and Setpoint Weighting**


**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

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

REFERENCE BOOKS

COURSE OUTCOMES
At the end of the course the students will be able to:
1. Understand the basics of PID control.(Unit I)
2. Implement Anti-windup strategies.(Unit II)
3. Design a PID controller.(Unit III)
4. Understand the robust performance.(Unit–IV )
5. Understand the need for Adaptive PID control. (Unit V)

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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

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

REFERENCES

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)

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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


Unit–II : Robot End Effectors, Sensors

**End Effectors:** Types-Mechanical grippers-Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops- Tools as end effectors - Robot/End-effectors interface- Consideration in Gripper selection and Design.

**Sensors:** Transducers and Sensors – Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor based systems- Machine Vision System.

Unit–III : Programming and Control of Robots

**Robot Programming:** Methods of Programming-: Leadthrough Methods, Robot program as a path in space- Motion interpolation, WAIT, SIGNAL and DELAY Commands, Branching, Capabilities and limitations of Leadthrough Methods- Textual Robot Programming- structure, Motion, End effectors and Sensor commands, Program control communication, Monitor mode commands
**Robot Control:** Open and Closed loop control - control Problem- Linear control Schemes- Design of Partitioned PD, PID and Adaptive Controllers for Linear Second order SISO Model of robot and their Block schematic representation- Control of Industrial Robots Using PLCS.

**Unit-IV : Automation**

**Factory Automation:** Fixed Automation, Flexible Automation and Programmable Automation. Intelligent Industrial Automation, Industrial Networking, Bus Standards


**Unit-V : Applications of Robots**

Factors influencing the selection of Robots – Robots for Welding, Painting, Assembly, Nuclear, Thermal and Chemical Plants.


**TEXT BOOKS**


**REFERENCES**


**COURSES 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)

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</table>
1. To provide basic knowledge of optical fibers and their properties.
2. To expose adequate knowledge about the Industrial applications of optical fibers.
3. To disseminate the students, the fundamental characteristics, types and industrial applications of optical laser.
4. To provide adequate facts about holography and medical applications of optical laser.

Unit-I
Principles of light propagation through a fiber - Basic optical laws and definitions - Different types of fibers and their properties, fiber characteristics - Wave Propagation-Fiber Losses- Dispersion - Connectors and splicers - Optical sources and detectors.

Unit-II

Unit-III

Unit-IV
Laser for measurement of distance, length, velocity, acceleration and current, voltage – Material processing: Laser heating, welding, melting and trimming of material – Laser spectroscopy.

Unit-V

TEXT BOOKS

REFERENCES
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)

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18EIHESCN | PROCESS DATA ANALYTICS |
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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

Unit – II Discrete time system models for control:

Unit – III Recursive Plant Model identification in open-loop:

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**


**REFERENCES**


**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)

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Mapping of COs with POs
## 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


### TEXTBOOKS


### REFERENCES


### 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)
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COURSE OBJECTIVES

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

Unit I

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

Unit II

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

Unit III

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

Unit-IV


Unit-V

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

TEXT BOOKS


REFERENCES

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).

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

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

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

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

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

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

TEXT BOOKS
2. Shawney A K, A course in Electrical and Electronic Measurements and
REFERENCES

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

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

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

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

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

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

Unit–V
Calibration and selection of Flow meters.
TEXT BOOKS

REFERENCES

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

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-course objectives
- To expose the students to the fundamentals of feedback control system.
- To analyse variety of classical control schemes using simulation software

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

Unit-II
Order and type of system – time domain and frequency domain response of different system characteristics using simulation software – Introduction of stability – Routh Hurwitz stability criteria.

Unit-III
Unit-IV
Introduction to different compensator design – the design of different compensator design using simulation software.PID controller design using simulation software.

Unit-V
Application of control system for different domain with case studies.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
At the end of the course the students will be able to
1. The student learns the importance of feedback control system. (Unit-I)
2. The student understands time domain and frequency domain techniques using simulation software. (Unit-II & III)
3. The student is exposed to classical control design using simulation software (Unit IV & V).

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

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

Unit–II
Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction- Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.
Unit–III
Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

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

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

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
At the end of the course the students will be able to
1. Design and development of PLC ladder programming for simple process applications.
2. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system.
3. Understand the popular process automation technologies
4. Know the latest communication technologies like HART and Field bus protocol

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18EIMISCN | INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES | L | T | P | C |
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Course Objectives
- To understand the operations of petrochemical industries.
- To be familiar with the control loops in petrochemical industries.

Unit-I :Oil Extraction and Processing
Techniques used for oil discovery - seismic survey - methods of oil extraction - oil rig system - Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator - scrubber – coalesce.
Unit-II: Petroleum Refining
Petroleum refining process - unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum

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

Unit-IV: Control Loops in Petrochemical Industry
Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

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

TEXT BOOKS:

REFERENCES

Course OutComeS
At the end of the course the students will be able to
1. Understand the principle and working of Oil Industries.(Unit I)
2. Understand the refining process in Oil Industries (Unit II)
3. To know the petroleum by-products.(Unit III)
4. Analyse the control loops in petrochemical industries.(Unit IV)
5. To know the safety in instrumentation systems.(Unit V)

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