PONDICHERRY UNIVERSITY

Bachelor of Technology

ROBOTICS AND AUTOMATION

REGULATIONS, CURRICULUM AND SYLLABUS

(2019- 2020)
1. CONDITIONS FOR ADMISSION:

(a) Candidates for admission to the first semester of the 8 semester B.Tech. Degree programme should be required to have passed:

The Higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks (a mere pass for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ Computer Science / Biology (Botany & Zoology) or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semesters B.Tech programme:

The minimum qualification for admission is a pass in three year diploma or four year sandwich diploma course in engineering / technology with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in any B.Sc. course with mathematics as one of the subjects of study with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in main and ancillary subjects excluding language subjects. The list of diploma programs approved for admission for each of the degree programs is given in Annexure A.

2. AGE LIMIT:

The candidate should not have completed 21 years of age as on 1st July of the academic year under consideration. For Lateral Entry admission to second year of degree programme, candidates should not have completed 24 years as on 1st July of the academic year under consideration. In the case of SC/ST candidates, the age limit is relaxable by 3 years for both the cases.

3. DURATION OF PROGRAMME:

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.
4. ELIGIBILITY FOR THE AWARD OF DEGREE:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8 semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. BRANCHES OF STUDY:

Branch I  - Civil Engineering
Branch II - Mechanical Engineering
Branch III - Electronics & Communication Engineering
Branch IV  - Computer Science & Engineering
Branch V  - Electrical & Electronics Engineering
Branch VI - Chemical Engineering
Branch VII - Electronics & Instrumentation Engineering
Branch VIII - Information Technology
Branch IX - Instrumentation & Control Engineering
Branch X  - Biomedical Engineering
Branch XI - Robotics and Automation

or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. SUBJECTS OF STUDY:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.

7. EXAMINATIONS:

The theory and practical examinations shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April / May).

(a) Theory courses for which there is a written paper of 75 marks in the university examination.

The Internal Assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows:
5 marks for 95% and above
4 marks for 90% and above but below 95%
3 marks for 85% and above but below 90%
2 marks for 80% and above but below 85%
1 mark for 75% and above but below 80%

A minimum of three tests are to be conducted for every theory subject and, of them two best are to be considered for computation of internal assessment marks.

(b) Practical courses for which there is a university practical examination of 50 marks:
Every practical subject carries an internal assessment mark of 50 distributed as follows:
(i) Regular laboratory exercises and record – 20 marks
(ii) Internal practical test – 15 marks
(iii) Internal viva-voce – 5 marks and
(iv) Attendance – 10 marks.

The marks earmarked for attendance are to be awarded as follows:
10 marks for 95% and above
8 marks for 90% and above but below 95%
6 marks for 85% and above but below 90%
4 marks for 80% and above but below 85%
2 marks for 75% and above but below 80%

8. REQUIREMENT FOR APPEARING FOR UNIVERSITY EXAMINATION:

A candidate shall be permitted to appear for university examinations at the end of any semester only if:

(i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.

(Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by the University along with a medical certificate obtained from a medical officer not below the rank of Assistant Director)

(ii) He / She earns a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester.

(iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution.

A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.
9. PROCEDURE FOR COMPLETING THE COURSE:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semesters for students admitted under lateral entry).

10. PASSING MINIMUM:

(i) A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (Internal Assessment plus University examination marks) and not less than 40% of the marks in University examination.

(ii) A candidate who has been declared “Failed” in a particular subject may reappear for that subject during the subsequent semesters and secure a pass. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

(a) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(b) The candidate should have attended all the college examinations as well as university examinations.

(c) If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.

(d) The request for revaluation must be made in the format prescribed duly recommended by the Head of the Institution along with the revaluation fee prescribed by the University.

The internal assessment marks obtained by the candidate shall be considered only in the first attempt for theory subjects alone. For the subsequent attempts, University examination marks will be made up to the total marks. Further the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.

11. AWARD OF LETTER GRADES:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain
points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

<table>
<thead>
<tr>
<th>Range of Total Marks</th>
<th>Letter Grade</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 to 100</td>
<td>S</td>
<td>10</td>
</tr>
<tr>
<td>80 to 89</td>
<td>A</td>
<td>9</td>
</tr>
<tr>
<td>70 to 79</td>
<td>B</td>
<td>8</td>
</tr>
<tr>
<td>60 to 69</td>
<td>C</td>
<td>7</td>
</tr>
<tr>
<td>55 to 59</td>
<td>D</td>
<td>6</td>
</tr>
<tr>
<td>50 to 54</td>
<td>E</td>
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<td>0 to 49</td>
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</tr>
<tr>
<td>Incomplete</td>
<td>FA</td>
<td></td>
</tr>
</tbody>
</table>

Note: “F” denotes failure in the course. “FA” denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.

(b) The list of courses enrolled during the semester and the grades scored.

(c) The Grade Point Average (GPA) for the semester and The Cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grades points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses

\[
\text{GPA} = \frac{\text{Sum of}(C \times GP)}{\text{Sum of } C}
\]

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA.

(e) The conversion of CGPA into percentage marks is as given below

\[
\% \text{ Mark} = (\text{CGPA} - 0.5) \times 10
\]

12. AWARD OF CLASS AND RANK:

(i) A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for
lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

(i) A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION**.

(ii) A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

(iv) All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

(v) For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from 1st to 8th semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 8th semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

13. **PROVISION FOR WITHDRAWAL:**

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded **DISTINCTION** whereas they are not eligible to be awarded a rank.

14. **DISCONTINUATION OF COURSE:**

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed 7 years, including of the period of discontinuance.
16. REVISION OF REGULATIONS AND CURRICULUM:

The University may from time to time revise, amend or change the regulations of curriculum and syllabus as and when found necessary.

ANNEXURE – A

(Diploma programs for admission for B.Tech. Lateral Entry)

<table>
<thead>
<tr>
<th>B.Tech courses in which admission is sought</th>
<th>Diploma courses eligible for admission</th>
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<tbody>
<tr>
<td>Civil Engineering</td>
<td>Civil Engineering</td>
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<tr>
<td></td>
<td>Civil and Rural Engineering</td>
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<tr>
<td></td>
<td>Architectural Assistantship</td>
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<tr>
<td></td>
<td>Architecture</td>
</tr>
<tr>
<td></td>
<td>Agricultural Engineering</td>
</tr>
</tbody>
</table>

| Mechanical Engineering                     | Mechanical Engineering                |
|                                            | Automobile Engineering                |
|                                            | Agricultural Engineering              |
|                                            | Mechanical and Rural Engineering      |
|                                            | Refrigeration and Air-conditioning    |
|                                            | Agricultural Engineering & Farm Equipment |
|                                            | Technology                            |
|                                            | Metallurgy Production Engineering     |
|                                            | Machine Design & Drafting             |
|                                            | Machine tool maintenance and Repairs  |
|                                            | Printing Technology / Engineering     |
|                                            | Textile Engineering / Technology      |
|                                            | Tool Engineering                      |

| Electrical and Electronics Engineering     | Electrical Engineering               |
| Electronic & Communication Engineering    | Electrical and Electronics Engineering|
| Electronic and Instrumentation Engineering | Electronics and Instrumentation Engineering|
| Instrumentation and Control Engineering    | Instrumentation Engineering / Technology|
| Bio Medical Engineering                    | Electronics and Communication Engg.   |
|                                            | Electronics Engineering               |
|                                            | Medical Electronics                   |
|                                            | Instrumentation and Control Engineering|
|                                            | Applied Electronics                   |

| Robotics and Automation Engineering        | Electrical and Electronics Engineering|
|                                            | Electronics and Communication Engineering|
|                                            | Electronics and Instrumentation Engineer |
|                                            | Computer Science and Engineering      |
|                                            | Information Technology                |
|                                            | Instrumentation and Control Engineering|
|                                            | Mechanical Engineering                |
|                                            | Automobile Engineering                |
|                                            | Refrigeration and Air-conditioning    |
|                                            | Production Engineering                |
| Chemical Engineering | Chemical Engineering  
|                      | Chemical Technology  
|                      | Petrochemical Technology  
|                      | Petroleum Engineering  
|                      | Ceramic Technology  
|                      | Plastic Engineering  
|                      | Paper & Pulp Technology  
|                      | Polymer Technology  
| Information Technology | Computer Science and Engineering  
| Computer Science & Engineering | Computer Technology  
|                      | Electrical and Electronics Engineering  
|                      | Electronics & Communication Engineering  
|                      | Electronics & Instrumentation Engineering  
|                      | Instrumentation Engineering / Technology |
Curriculum

for

B.Tech.

Robotics and Automation

2019-2020
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- **PEO1: Employability**: Our Graduates shall be suitably employed with professional competency and knowledge of modern tools.

- **PEO2: Higher Education**: Our Graduates shall be capable to pursue higher studies/research in the field of engineering and management.

- **PEO3: Entrepreneurship**: Our Graduates shall be prepared for a successful career by meeting ever increasing demands required by Robotics and Automation profession and enable them to become an entrepreneur.

- **PEO4: Professional and Ethical values**: Our Graduates cultivate professional and ethical attitudes with effective communication skills, team work and multidisciplinary approach related to engineering issues.

PROGRAM OUTCOMES (POs)

Graduating students of Robotics and Automation Engineering from Pondicherry University will have the ability to:

- **PO1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

- **PO2: Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **PO3: Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

- **PO4: Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
• **PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

• **PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

• **PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

• **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

• **PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

• **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

• **PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

• **PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
# PONDICHERRY UNIVERSITY

## B.Tech (Robotics and Automation)

### CURRICULUM

## I SEMESTER

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of the Subjects</th>
<th>Periods</th>
<th>Credits</th>
<th>Marks</th>
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<td>T</td>
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<td>T102</td>
<td>Physics</td>
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<td>T103</td>
<td>Chemistry</td>
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<td>T110</td>
<td>Basic Civil and Mechanical Engineering</td>
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<tr>
<td>T111</td>
<td>Engineering Mechanics</td>
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<tr>
<td>T112</td>
<td>Communicative English</td>
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<td>P104</td>
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<td>P105</td>
<td>Chemistry Laboratory</td>
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## II SEMESTER

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<th>Periods</th>
<th>Credits</th>
<th>Marks</th>
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<tr>
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<td>T107</td>
<td>Mathematics – II</td>
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<td>T109</td>
<td>Environmental Science</td>
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<tr>
<td>T104</td>
<td>Basic Electrical and Electronics Engineering</td>
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<td>Engineering Thermodynamics</td>
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<td>T106</td>
<td>Computer Programming</td>
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<td>P101</td>
<td>Computer Programming Laboratory</td>
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<td>P102</td>
<td>Engineering Graphics</td>
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<td>3</td>
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<td>P103</td>
<td>Basic Electrical and Electronics Laboratory</td>
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### III SEMESTER

<table>
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<th>Name of the Subjects</th>
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<th>Credits</th>
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<td>RA T33</td>
<td>Programming in Python</td>
<td>4</td>
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<td>RA T34</td>
<td>Sensors and Instrumentation</td>
<td>4</td>
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<td>RA T35</td>
<td>Electrical Machines and Drives</td>
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<tr>
<td>RA T36</td>
<td>Strength of Materials</td>
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<td>1</td>
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</table>

**Practical**

|          |                                           |         |       | |
| RA P31  | Electronic Devices and Circuits Laboratory| - | - | 3 | 2 | 50 | 50 | 100 |
| RA P32  | Programming in Python Laboratory         | - | - | 3 | 2 | 50 | 50 | 100 |
| RA P33  | Electrical Machines and Drives Laboratory| - | - | 3 | 2 | 50 | 50 | 100 |

**Total**

<table>
<thead>
<tr>
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<th>Theory</th>
<th>Practical</th>
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### IV SEMESTER

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<th>Name of the Subjects</th>
<th>Periods</th>
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<td></td>
<td></td>
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<td>RA T41</td>
<td>Fourier Series and Partial Differential Equations</td>
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<td>RA T42</td>
<td>Principles of Robotics</td>
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<td>-</td>
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<td>RA T43</td>
<td>Analog and Digital Electronics</td>
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<td>RA T44</td>
<td>Automatic Control Systems</td>
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<td>RA T45</td>
<td>Kinematics and Dynamics of Machines</td>
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<td>RA T46</td>
<td>Hydraulics and Pneumatics</td>
<td>4</td>
<td>-</td>
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</table>

**Practical**

|          |                                           |         |       | |
| RA P41  | Analog and Digital Electronics Laboratory| - | - | 3 | 2 | 50 | 50 | 100 |
| RA P42  | Kinematics and Dynamics Laboratory        | - | - | 3 | 2 | 50 | 50 | 100 |
| RA P43  | Hydraulics and Pneumatics Laboratory      | - | - | 3 | 2 | 50 | 50 | 100 |
| SP P44  | Physical Education *                      | - | - | - | - | - | - | - |

**Total**

<table>
<thead>
<tr>
<th></th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22</td>
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</table>

* Student is required to secure a pass and no grade will be awarded
### V SEMESTER

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of the Subjects</th>
<th>Periods</th>
<th>Credits</th>
<th>Marks</th>
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<td>RA T52</td>
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<td>RA T53</td>
<td>Programmable Logic Controllers</td>
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<td>RA T54</td>
<td>Robotic Control Systems</td>
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#### Practical

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<td>RA P51</td>
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<td>RA P52</td>
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Total 22 2 12 31 400 600 1000

### VI SEMESTER

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<td>RA T61</td>
<td>Modeling and Simulation</td>
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<td>RA T62</td>
<td>Robot Kinematics and Dynamics</td>
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<td>Programming for Robotics</td>
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<td>RAT64</td>
<td>Automation System Design</td>
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<td>Design of Mechanical Transmission Systems</td>
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#### Practical

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Total 21 3 12 31 375 525 900
## VII SEMESTER

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<td>RA T71</td>
<td>Industrial Robotics and Material Handling</td>
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<td>RA T72</td>
<td>Artificial Intelligence for Robotics</td>
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<td>Innovative Practices</td>
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## VIII SEMESTER

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Total credits – 232
# Professional Electives for Robotics and Automation

## List of Electives

### Semester V - Elective I

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of the Subjects</th>
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<tr>
<td>RA E01</td>
<td>VLSI Design</td>
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<td>RA E02</td>
<td>Soft Computing</td>
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<td>RA E03</td>
<td>Industrial Networking</td>
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<td>RA E04</td>
<td>Field and Service Robotics</td>
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<td>RA E05</td>
<td>PC based Industrial Automation</td>
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### Semester VI - Elective II

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<td>RA E06</td>
<td>Image Processing and Vision Systems</td>
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<td>RA E07</td>
<td>FPGA Based System Design</td>
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<td>RA E08</td>
<td>Industrial Drives for Automation</td>
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<td>Applied Robotics</td>
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<td>Wireless Sensor Networks for Robotics</td>
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### Semester VII - Elective III

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<td>RA E12</td>
<td>Mobile Robotics</td>
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<td>RA E13</td>
<td>Vision Guided Robotics</td>
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<td>RA E14</td>
<td>Medical Robotics</td>
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<td>RA E15</td>
<td>Industrial IoT &amp; Automation</td>
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### SEMESTER VII - ELECTIVE IV

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<td>RA E17</td>
<td>Computer Integrated Manufacturing</td>
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<td>RA E18</td>
<td>Reliability and Quality control</td>
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<td>RA E19</td>
<td>Process Planning and Cost Estimation</td>
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<td>Micro and Nano Electromechanical Systems</td>
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### SEMESTER VIII - ELECTIVE V

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<td>RA E21</td>
<td>Cognitive Robotics</td>
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<td>RA E22</td>
<td>Machine Learning for Robotics</td>
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<td>RA E23</td>
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<td>RA E24</td>
<td>COBOT(Collaborative Robotics)</td>
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<td>RA E25</td>
<td>Product Design and Development</td>
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### SEMESTER VIII - ELECTIVE VI

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<td>RA E27</td>
<td>Entrepreneurship Development</td>
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<td>RA E28</td>
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<td>RA E29</td>
<td>Total Quality Management</td>
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<td>RA E30</td>
<td>Supply Chain Management</td>
<td>4 - -</td>
<td>4</td>
<td>25 75 100</td>
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</table>
COURSE OBJECTIVES

- To introduce and familiarize with functions of several variables and the idea of applying calculus concepts to problems in Engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To introduce effective mathematical tools for the solutions of differential equations that model physical processes.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of mathematics to solve functions of several variables.
- Identify, formulate, and solve engineering problems like multiple integrals and their usage.
- To solve differential equations that model physical processes using effective mathematical tools

UNIT I: CALCULUS
Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties. (12)

UNIT II: FUNCTIONS OF SEVERAL VARIABLES
Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Taylor’s series for functions of two variables, Maxima and minima, Lagrange’s method of undetermined multipliers. (12)

UNIT III: MULTIPLE INTEGRALS AND APPLICATIONS
Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar). (12)

UNIT IV: DIFFERENTIAL EQUATIONS
Exact equations, First order linear equations, Bernoulli’s equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut’s type. (12)

UNIT V: DIFFERENTIAL EQUATIONS (HIGHER ORDER)
Linear differential equations of higher order – with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method simple applications to electric circuits. (12)

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transform modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines.
- To understand the concepts and applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of science and engineering to understand physics and its significant contributions in the advancement of technology and invention of new products that dramatically transform modern-day society.
- Identify different areas of physics which have direct relevance and applications to different Engineering disciplines.
- Apply fundamental knowledge to understand applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

UNIT I: ACOUSTICS & NDT


(9)

UNIT II: OPTICS


(9)

UNIT III: LASERS & FIBER OPTICS


(9)

UNIT IV: WAVE MECHANICS


(9)

UNIT V: NUCLEAR ENERGY SOURCE


(9)
TEXT BOOKS:
1. V Rajendran, Engineering Physics, 2nd Ed., TMH, New Delhi 2011 (For Units I to IV only)
2. Arthur Beiser, Concept of Modern Physics, 6th Ed, TMH, New Delhi 2008 (For Unit V Only)

REFERENCE BOOKS:
COURSE OBJECTIVES
- To know about the importance of Chemistry in Engineering domain
- To understand the chemistry background of industrial process
- To apply chemistry knowledge for engineering disciplines

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Apply knowledge of science and engineering to understand the importance of Chemistry in Engineering domain
- Identify different Electrochemical cells and their usage for industrial process
- Apply fundamental knowledge of chemistry and build an interface of theoretical concepts with industrial applications / engineering applications.

UNIT I : WATER

UNIT II : POLYMERS

UNIT III: ELECTROCHEMICAL CELLS

UNIT IV: CORROSION AND ITS CONTROL

UNIT V: PHASE RULE
Definition and derivation of phase rule. Application to one component system - water and sulphur systems. Thermal analysis, condensed phase rule. Two component alloy systems - Pb-Ag, Cu-Ni and Mg-Zn systems.

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To be able to differentiate the types of buildings according to national building code and understand building components and their functions as well as different types of roads, bridges and dams.
- To explain the concepts of thermal systems used in power plants and narrate the methods of harnessing renewable energies
- To explain the role of basic manufacturing processes and develop an intuitive understanding of underlying working principles of mechanical machines and systems.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Get an idea about construction procedure and steps involved in component design of the building.
- Understand the manufacturing processes such as casting, forming, joining, and machining
- Apply the Functions of Prime movers, working of IC engines and refrigerator Understand.

PART - A CIVIL ENGINEERING

UNIT I: BUILDINGS, BUILDING MATERIALS
Buildings-Definition-Classification according to NBC- plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick, cement, cement-mortar, concrete, steel- their properties and uses.

UNIT II: BUILDINGS AND THEIR COMPONENTS
Buildings- Various Components and their functions. Soils and their classification Foundations- Functions and types of foundations, Masonry - Function and types, Floors- Definition and types of floors, Roofs : Definition and types.

UNIT III: BASIC INFRASTRUCTURE

PART - B MECHANICAL ENGINEERING

UNIT IV: INTERNAL AND EXTERNAL COMBUSTION SYSTEMS
IC engines – Classification – working principles – Diesel and petrol engines: two stroke and four stroke engines. Merits and demerits.
Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers)– Boiler mountings and accessories. Merits and demerits- Applications.

UNIT V: POWER GENERATION SYSTEMS
UNIT VI: MANUFACTURING PROCESS

(10)

TEXT BOOKS:
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI).
3.

REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions
- To comprehend the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation
- To emphasis the concepts through solved examples

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of mathematics, science and engineering to analyze the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions
- Design and conduct experiment, as well as to analyze the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and analyze dynamic equilibrium equation
- Design, construct and analyze Engineering Mechanics through solved examples

UNIT I: FUNDAMENTAL OF MECHANICS

Fundamental of Mechanics: Basic Concepts Force System and Equilibrium, Definition of Force, Moment and Couple, Principle of Transmissibility, Varignon’s theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies. (12)

UNIT II: PRACTICAL APPLICATION OF FORCE SYSTEM

Structural member: definition, Degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of Trusses-method of joints, method of sections. Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges. (12)

UNIT III: PROPERTIES OF SURFACES

Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia. (12)

UNIT IV: KINEMATICS AND KINETICS OF PARTICLES


UNIT V: KINEMATICS AND KINETICS OF RIGID BODIES

Plane motion, Absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum. (12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To improve the LSRW skills of I year B.Tech students
➢ To instill confidence and enable the students to communicate with ease
➢ To equip the students with the necessary skills and develop their language prowess

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Apply fundamental knowledge to improve the LSRW skills of I year B.Tech students
➢ To enable the students to communicate with ease
➢ Apply basic knowledge to equip the students with the necessary skills and develop their language prowess

UNIT I : BASIC COMMUNICATION THEORY

Importance of Communication – stages of communication, modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills. (12)

UNIT II: COMPREHENSION AND ANALYSIS

Comprehension of technical and non-technical material- Skimming, scanning, inferring-Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing. (12)

UNIT III: WRITING

Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, Definitions, Practice in Summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc. (12)

UNIT IV: BUSINESS WRITING / CORRESPONDENCE


UNIT V: ORAL COMMUNICATION


TEXT BOOKS:


REFERENCE BOOKS

COURSE OBJECTIVES
➢ To provide a practical understanding of some of the concepts learnt in the theory course on Physics.

COURSE OUTCOMES
➢ An ability to understand, explain and use instrumental techniques for intensity pattern analysis
➢ Ability to operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power
➢ Capable of handling screw gauge, vernier caliper and travelling microscope to calculate the required parameters
➢ Acquire basic knowledge about thermal conduction and magnetic field due to a current carrying coil

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)
1. Thermal conductivity – Lee’s DISC
2. Thermal conductivity - Radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer - Ordinary & Extraordinary rays
6. Newton’s rings
7. Air – wedge
8. Half shade polarimeter – Determination of specific rotatory power
9. Jolly’s experiment – determination of α
10. Magnetism: i – h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe / four probe method
17. Hall effect in semiconductor
COURSE OBJECTIVES

- To gain a practical knowledge of Engineering Chemistry in relevance to Industrial applications

COURSE OUTCOMES

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permanganometry.
12. Estimation of iron by colorimetry

DEMONSTRATION EXPERIMENTS (ANY TWO OF THE FOLLOWING)

1. Determination of COD of water sample.
2. Determination of lead by conductometry.
3. Percentage composition of sugar solution by viscometry
COURSE OBJECTIVES
- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering
- To develop an intuitive understanding of underlying physical mechanism used in mechanical machines.

COURSE OUTCOMES
- To acquire skills in basic engineering practice.
- To identify the hand tools and instruments.
- To acquire measuring skills.
- To acquire practical skills in the trades.
- To provides the knowledge of job materials in various shops.

I FITTING
Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle
1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II WELDING
Study of arc and gas welding equipment and tools – Edge preparation – Exercises on lap joint and V Butt joints – Demonstration of gas welding
1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. Single V butt welding (Arc)

III SHEET METAL WORK
Study of tools and Machineries – exercises on simple products like Office tray and waste collection tray
1. Study of tools and machineries
2. Funnel
3. Waste collection tray

IV CARPENTRY
Study of tools and Machineries – Exercises on Lap joints and Mortise joints
1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint
COURSE OBJECTIVES

- To develop the use of matrix algebra techniques for practical applications and to introduce the concepts of Curl, Divergence and integration of vectors in vector calculus which is needed for many application problems.
- To introduce Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations.
- To acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of mathematics to solve matrix algebra techniques for practical applications and Curl, Divergence and integration of vectors in vector calculus for many application problems.
- Identify, formulate, and solve engineering problems like Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations.
- Apply formulae and analyze problems of Fourier transform techniques.

UNIT I: MATRICES


UNIT II: VECTOR CALCULUS

Vector Calculus: Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke's theorem (without proof). Simple application problems. (12)

UNIT III: LAPLACE TRANSFORM

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems. (12)

UNIT IV: APPLICATIONS OF LAPLACE TRANSFORM


UNIT V: FOURIER TRANSFORM

Fourier Integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval's identity. (12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
To understand the importance of Material Science as a subject that revolutionized modern day technologies
➢ To understand the significance of material science in the development of new materials and devices for all branches of Engineering
➢ To impart knowledge to the Engineering students about some of the important areas of Materials Science so as to enable them perceive the significant contributions of the subject in Engineering and Technology

6. COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Apply core concepts in Materials Science to solve engineering problems.
➢ Knowledgeable of contemporary issues relevant to Materials Science and Engineering.
➢ Select materials for design and construction.
➢ Understand the importance of life-long learning.

UNIT I: CRYSTAL STRUCTURE AND DEFECTS
Crystal structure - Bravais Lattices, Crystal Systems - Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method. Lattice defects – Qualitative ideas of point, line, surface and volume defects.

UNIT II: DIELECTRIC PROPERTIES

UNIT III: MAGNETIC PROPERTIES

UNIT IV: SEMICONDUCTORS AND SUPERCONDUCTORS
UNIT V: ADVANCED MATERIALS
Liquid Crystals – Types – Application as Display Devices Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications, Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA Nanomaterials - Nano materials (one, Two & three Dimensional) – Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials, carbon nanotubes – synthesis, Properties and applications.

TEXT BOOKS:


REFERENCE BOOKS:

COURSE OBJECTIVES
 To know about the environment
 To understand about environmental pollution
 To apply the knowledge in understanding various environmental issues and problems

COURSE OUTCOMES
On successful completion of the module students will be able to:
 Apply fundamental knowledge to understand about the environment
 Identify environmental pollution through science
 Apply basic knowledge to solve various environmental issues and problems

UNIT I: ENVIRONMENT AND ENERGY RESOURCES

UNIT II: ECOSYSTEM & BIODIVERSITY

UNIT III: AIR POLLUTION

UNIT IV: WATER AND LAND POLLUTION

UNIT V: POLLUTION CONTROL AND MONITORING
Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas
Chromatography and Conductometry. Analysis of air pollutants – NOx, COx, SOx, H2S, Hydrocarbons and particulates.

**TEXT BOOKS:**
2. A.K. De, "Environmental chemistry‖ 6rd edition; New age international (P) Ltd, New Delhi, 2006

**REFERENCE BOOKS:**
COURSE OBJECTIVES

➢ To understand and gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines.
➢ To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flipflops.
➢ To understand the measuring devices in electronics.
➢ To gain knowledge on various communication systems and network models.

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Will gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines.
➢ Will gain basic knowledge on instruments for measurements, communication systems and network models.

PART – A - ELECTRICAL

UNIT I: DC CIRCUIT
Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm’s law, Kirchhoff’s law & its applications – Simple Problems - Division of current in Series & parallel circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits. (10)

UNIT II: AC CIRCUIT
Concepts of AC circuits – rms value, average value, form and peak factors - Simple RLC series circuits – Concept of real and reactive power – Power factor - Introduction to three phase system - Power measurement by two wattmeter method. (10)

UNIT III: ELECTRICAL MACHINES AND POWER PLANTS:
Law of Electromagnetic induction, Fleming’s Right & Left hand rule - Principle of DC rotating machine, Single phase transformer and single phase induction motor (Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only). Fundamentals of fuses and circuit breakers. (10)

PART – B – ELECTRONICS

UNIT IV: ELECTRONIC CIRCUIT
V-I Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter - Transistor - Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET. (10)

UNIT V: DIGITAL ELECTRONICS
Boolean algebra – Reduction of Boolean expressions - De-Morgan’s theorem – Logic gates - Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic - Ripple counters and shift registers. (10)

UNIT VI: COMMUNICATION AND COMPUTER SYSTEMS
Model of communication system - Analog and digital - Wired and wireless channel. Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system. Network model - PAN, LAN, MAN and WAN - Circuit and packet switching – Overview of ISDN. (10)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
➢ To develop methodologies for predicting the system behavior and establish the importance of laws of thermodynamics applied to energy systems
➢ To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

COURSE OUTCOMES
On successful completion of the module students will be able to:
➢ Apply knowledge of mathematics, science and engineering to understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
➢ Design and conduct experiment, as well as to analyze and develop methodologies for predicting the system behavior and understand the importance of laws of thermodynamics applied to energy systems
➢ Identify and analyze role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

UNIT I: BASIC CONCEPTS AND DEFINITIONS

UNIT II: FIRST LAW OF THERMODYNAMICS
The concept of work and adiabatic process - First law of thermodynamics - Conservation of Energy principle for closed and open systems - Calculation of work for different processes of expansion of gases. (12)

UNIT III: SECOND LAW OF THERMODYNAMICS
Equilibrium and the second law - Heat engines - Kelvin-Planck statement of second law of thermodynamics - Reversible and irreversible processes - Carnot principle - Clausius inequality- Entropy. (12)

UNIT IV: GAS POWER CYCLES
Air standard cycles: The air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and Bryton cycles and their efficiencies. (12)

UNIT V: REFRIGERATION CYCLES AND SYSTEMS
Reverse Carnot cycle - COP - Vapor compression refrigeration cycle and systems (only theory) - Gas refrigeration cycle - Absorption refrigeration system - Liquefaction and solidification (only theory) (12)

TEXT BOOKS:
REFERENCE BOOKS:
COURSE OBJECTIVES

- To introduce the basics of computers and information technology and educate problem solving techniques.
- To impart programming skills in C language.
- To practice structured programming to solve real life problems.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Know concepts in problem solving
- To do programming in C language
- To write diversified solutions using C language
- To know about structures, pointers and its manipulation.

UNIT I


UNIT II


UNIT III


UNIT IV

Structures – Arrays and Structures – nested structures – passing structures to functions – user defined data types– Union. Pointers – pointers and arrays – pointers and functions - pointers and strings - pointers and structures. (12)

UNIT V

Files – operations on a file – Random access to files – command line arguments .Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives. (12)

TEXT BOOKS:


REFERENCE BOOKS:

COURSE OBJECTIVES
- To introduce the basics of computers and information technology and educate problem solving techniques.
- To impart programming skills in C language and gain a hands on experience of compilation and execution of ‘c’ programs.
- To practice structured programming to solve real life problems.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Know concepts in problem solving
- To do programming in C language
- To write diversified solutions using C language

LIST OF EXERCISES
1. Study of OS Commands
2. Write a C program to find the Area of the triangle.
3. Write a C program to find the total and average percentage obtained by a student for 6 subjects.
4. Write a C program to read a three digit number and produce output like
   - 1 hundreds
   - 7 tens
   - 2 units for an input of 172.
5. Write a C program to check whether a given character is vowel or not using Switch – Case statement.
6. Write a C program to print the numbers from 1 to 10 along with their squares.
7. Write a C program to find the sum of ‘n’ numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of Local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.
COURSE OBJECTIVES

- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments made in drawing that are used in real systems
- To explain the role of computer aided design _Auto Cad
- To develop an intuitive understanding of underlying significance of using these Drawings

COURSE OUTCOMES

On successful completion of this course, the student will be able to familiarize with the fundamentals and standards of Engineering graphics

- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Project orthographic projections of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Visualize and to project isometric and perspective sections of simple solids.

UNIT I
Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning.

UNIT II
Conic sections, Involute, Spirals, Helix, Projection of Points, Lines and Planes Projection of Solids and Sections of Solids.

UNIT III
Development of surfaces - Intersection of surfaces (cylinder-cylinder, cylinder-cone)

UNIT IV
Isometric projections and Orthographic projections

UNIT V
Computer Aided Drafting: Introduction to Computer Aided Drafting hardware - Overview of application software - 2D drafting commands (Auto CAD) for simple shapes - Dimensioning

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications.
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
- To gain a practical knowledge on the functions and application of basic logic gates and flip flops

COURSE OUTCOMES
On successful completion of this course, Students will be able to,
- Know about basic electrical tools, applications and precautions
- Perform different types of wiring used in domestic and industrial applications
- Measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
- Understand the functions and application of basic logic gates and flip flops

ELECTRICAL LAB

LIST OF EXPERIMENTS
1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor’s room wiring.
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters.

ELECTRONICS LAB

LIST OF EXPERIMENTS
1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou’s figures)
2. Verification of Kirchoff’s Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff’s laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier - Calculation of bandwidth.
5. Study of Logic Gates
   (a) Verification of Demorgan’s theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and Flipflops - JK, RS, T and D
   (c) Implementation of digital functions using logic gates and Universal gates.
NCC/NSS training is compulsory for all Undergraduate students

1. The activities will include Practical/field activities/Extension lectures.
2. The activities shall be carried out outside class hours.
3. For the above activities, the student participation shall be for a minimum period of 45 hours.
4. The activities will be monitored by the respective faculty in charge and the First Year Coordinator.
5. Pass/Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years.
6. Pass in this course is mandatory for the award of degree.
SEMESTER III

RA T31 LINEAR ALGEBRA

COURSE OBJECTIVES

➢ To introduce the basic notions of groups, rings, fields which will be used to solve related problems.
➢ To familiarize the applications of algebraic structures.
➢ To understand the concepts of vector space, linear transformations and diagonalization.
➢ To apply the concept of inner product spaces in orthogonalization.

COURSE OBJECTIVES

On successful completion of the module students will be able to:

➢ Understand the concepts and properties of algebraic structures such as groups, rings and fields.
➢ Demonstrate accurate and efficient use of advanced algebraic techniques.
➢ Demonstrate their mastery by solving non-trivial problems related to the concepts and by proving simple theorems.

UNIT I : GROUPS

Algebraic systems – Semi groups – Monoids – Groups – Subgroups – Homomorphism’s – Normal subgroup and cosets – Lagrange’s theorem. (12)

UNIT II : RINGS AND FIELDS

Rings - Sub-rings - Properties of rings – Fields - Integral domain - Ideals and Quotient rings – Polynomial rings. (12)

UNIT III : VECTOR SPACES

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions. (12)

UNIT IV : LINEAR TRANSFORMATION AND DIAGONALIZATION

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigen values and eigenvectors - Diagonalizability. (12)

UNIT V : INNER PRODUCT SPACES

Inner product- Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation. (12)

TEXTBOOKS:


REFERENCES:

COURSE OBJECTIVES

- To introduce the concepts of electron ballistics, the physics of semiconductors and various parameters of diodes.
- To learn and gain insight into the operation, characteristics and functional aspects of BJT, JFET, MOSFET, several special semiconductor devices.
- To design the different types of biasing in BJT, FET and MOSFET and analyze various rectifier circuits with filters and IC regulator circuits.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge science and engineering to understand semiconductor diodes, diode equation and characteristics.
- To analyze functional aspects of BJT, JFET, MOSFET and its biasing.
- Design and construct simple circuits like rectifiers, filters and IC regulators.

UNIT I: SEMICONDUCTOR DIODES


UNIT II: BIPOLAR JUNCTION TRANSISTOR


UNIT III: SPECIAL SEMICONDUCTOR DEVICES

Construction, principle of operation and characteristics of Schottky barrier diode, Varactor diode, Tunnel diode, PIN diode, LED, LCD, UJT, SCR, DIAC and TRIAC. Photoconductivity – photodiode, APD, phototransistor, LDR, optocoupler, solar cell, LASER diode and MESFET.

UNIT IV: BIASING AND STABILIZATION

DC load line and Q-point – Need for biasing – Different types of BJT biasing – Fixed bias, Collector to base bias, Self bias – Stability factor Bias compensation: Diode, Thermistor and Sensistor compensation – FET biasing: Gate bias, Voltage divider bias and Self bias – MOSFET biasing.

UNIT V: POWER SUPPLY


TEXT BOOKS:


REFERENCE BOOKS:

COURSE OBJECTIVES
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and use them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Read, write and execute simple programs by Python
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.

UNIT I: BASICS
Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Basic Syntax-Comments - Strings and Numeric Data Types - Simple Input and Output.

(12)

UNIT II: CONTROL STATEMENTS

(12)

UNIT III: FUNCTIONS

(12)

UNIT IV: ERROR HANDLING
Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions - Data Streams - Access Modes Writing - Data to a File Reading - Data from a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions - Working with Directories.

(12)

UNIT V: OBJECT ORIENTED FEATURES

(12)

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

COURSE OUTCOMES:
On successful completion of the module, students will be able to:
- Use the concepts in common methods for converting a physical parameter into an electrical quantity
- Classify the transducers and explain it with examples for measurement of temperature, strain, motion, position and light
- Choose proper sensor by comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
- Predict the expected performance of various sensors

UNIT I: INTRODUCTION

UNIT II: MOTION, PROXIMITY AND RANGING SENSORS

UNIT III: FORCE, MAGNETIC AND HEADING SENSORS

UNIT IV: OPTICAL, PRESSURE AND TEMPERATURE SENSORS

UNIT V: SIGNAL CONDITIONING AND DAQ SYSTEMS
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. (12)

TEXT BOOKS:
REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the operations of DC and AC machines.
- To analyze the performance of the special machines for different appliances.
- To study the basics of the Electric Drives unit
- To understand the operation and performance of conventional and solid state speed control of DC and AC drives

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Acquire knowledge on DC and AC machines.
- Know the features of the Synchronous and Special Machines
- Learn the different types of Electric Drives
- Acquire knowledge on DC and AC drives.

UNIT I: ELECTRICAL MACHINES


UNIT II: SYNCHRONOUS AND SPECIAL MACHINES


UNIT III: ELECTRIC DRIVES

Basic elements-types of electric drives-factors influencing electric drives-heating and cooling curves -loading conditions and classes of duty-Selection of power rating for drive motors with regard to thermal overloading and load variation factors. (12)

UNIT IV: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES

Conventional and solid state speed control of D.C Drives - Speed control of DC series and shunt motors-Armature and field control, Ward-Leonard control system using controlled rectifiers and DC choppers –applications. (12)

UNIT V: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES

Conventional and solid state speed control of AC drives -Speed control of induction motor-Voltage control, voltage/frequency control, slip power recovery scheme-using inverters and AC voltage regulators-applications. (12)

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To understand the concepts of stress, strain, principal stresses and principal planes.
➢ To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
➢ To determine stresses and deformation in circular shafts and helical spring due to torsion.
➢ To compute slopes and deflections in determinate beams by various methods.
➢ To study the selection of materials used for making components for robotics.

COURSE OUTCOMES
On successful completion of the module students will be able to:

➢ Understand the concepts of stress and strain in simple and compound bars, importance of principal stresses and principal planes.
➢ Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
➢ Apply basic equation of simple torsion in designing of shafts and helical spring
➢ Calculate the slope and deflection in beams using different methods.
➢ Analyze and design thin and thick shells for the applied internal and external pressure
➢ To analyze the type of materials and its suitability as per applications.

UNIT I: STRESS, STRAIN AND DEFORMATION OF SOLIDS

UNIT II: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM

UNIT III: TORSION
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV: DEFLECTION OF BEAMS & CYLINDERS
Double Integration method – Macaulay’s method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell’s reciprocal theorems, Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders.

UNIT V: MATERIALS FOR ROBOTICS:
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To design of Regulators and Amplifiers
- To verify the theoretical concepts through laboratory and simulation experiments.
- To execute mini projects based on implementation of electronic circuits concept.

COURSE OUTCOMES

After successful completion of the course student will be able to

- Understand the voltage - current characteristics of semiconductor devices
- Analyze DC circuits and relate AC models of semiconductor devices with their physical Operation
- Design and analyze the various electronic circuits

1. V-I characteristics of semiconductor diodes
   a) PN Junction diode
   b) Point contact diode
   c) Zener diode

2. Characteristics of BJT in CB configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics

3. Characteristics of BJT in CE configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics

4. Characteristics of JFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, $r_d$, $g_m$ and $\mu$ from the characteristics

5. Characteristics of MOSFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, $r_d$, $g_m$ and $\mu$ from the characteristics

6. Characteristics of UJT, SCR and TRIAC

7. Characteristics of photonic devices
   a) Determination of V-I characteristics of LED
   b) Determination of V-I and intensity characteristics of phototransistor

8. Design and testing of biasing circuits
   a) Fixed bias
   b) Collector to base bias
   c) Self bias

9. Rectifier and Voltage Regulators
   a) Determination of ripple factor for different types of rectifiers with and without filters.
   b) Voltage regulation characteristics of shunt, series and IC regulators

10. i) Clipper circuits using diodes
    Positive, negative, biased and combinational clips
    ii) Switching circuit
    a) AND and OR logic gates using diodes
    b) NOT gate using transistor
COURSE OBJECTIVES

- Learn Syntax, Semantics and create Functions in Python.
- Handle Strings and Files in Python.
- Understand Lists, Dictionaries and Regular expressions in Python.
- Implement Object Oriented Programming concepts in Python
- Build Web Services and introduction to Network and Database Programming in Python.

COURSE OUTCOMES

After successful completion of the course student will be able to

- Examine Python syntax, semantics and be fluent in using of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

LIST OF EXPERIMENTS:

1. Write a Python program to find GCD of two numbers.
2. Write a Python Program to find the square root of a number by Newton’s Method
3. Write a Python program to find the exponentiation of a number.
4. Write a Python Program to find the maximum from a list of numbers.
5. Write a Python Program to perform Linear Search
6. Write a Python Program to perform Binary Search
7. Write a Python Program to perform selection sort.
8. Write a Python Program to perform insertion sort.
9. Write a Python Program to perform Merge sort.
10. Write a Python program to find first N prime numbers.
11. Write a Python program to multiply matrices.
COURSE OBJECTIVES
- To understand the basics of electrical machines and trigger circuits required for various power converters.
- To acquire knowledge about the operation of various power converter circuits like Controlled rectifiers, Choppers, AC voltage regulators and Inverters.

COURSE OUTCOMES
- The course enables the students to do simulation of the circuits using MATLAB/Simulink and experimentally verify the simulation results in the hardware lab. Besides, the students are introduced with some of the application of the power converters.

LIST OF EXPERIMENT
1. Study of thyristors controlled DC Drive.
2. Study of Chopper fed DC Drive.
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed 3 phase Induction Motor control using MATLAB / PSIM Software.
5. VSI / CSI fed Induction motor Drive analysis using MATLAB / PSIM Software.
7. Study of Permanent Magnet Synchronous Motor drive fed by PWM Inverter using Software.
8. Regenerative / Dynamic braking operation for DC Motor - Study uses software.
10. PC based AC/DC motor control operation.
SEMESTER IV

RA T41 FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS

COURSE OBJECTIVES
- To introduce the basic concepts for solving standard partial differential equations.
- To provide the concept of Fourier series and expanding functions into Fourier series including Harmonic analysis.
- To make the students knowledgeable in the areas of Boundary Value Problems like vibrating string (wave equation), Heat equation in one and two dimensions.

COURSE OUTCOMES
On successful completion of the module students will be able to understand:
- How to solve the given standard partial differential equations.
- The physical significance of Fourier series techniques in solving one, two dimensional heat flow problems and one dimensional wave equations.

UNIT I: FOURIER SERIES

UNIT II:
Root Mean Square Value – Parseval’s theorem on Fourier Coefficients - Complex form of Fourier series – Harmonic Analysis. (12)

UNIT III: PARTIAL DIFFERENTIAL EQUATIONS
Formation of PDE by elimination of arbitrary constant and arbitrary function – General, Singular, particular and complete integrals - Lagrange’s linear first order equation - Higher order PDE with constant coefficients of both homogeneous and non-homogeneous types. (12)

UNIT IV: APPLICATION OF FOURIER SERIES
Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solution – Transverse vibration of an elastic string. (12)

UNIT V:
Fourier series solution for one dimensional heat flow equation – Fourier series solutions for two dimensional heat flow equations under steady state condition – (Cartesian and Polar forms) (excluding proof). (12)

TEXT BOOKS:
REFERENCES:
COURSE OBJECTIVES

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Ability to understand basic concept of robotics.
- To analyze Instrumentation systems and their various applications.
- To know about the differential motion add statics in robotics
- To know about the various path planning techniques.
- To know about the dynamics and control in robotics industries

UNIT I: BASIC CONCEPTS

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages. (12)

UNIT II: DIRECT AND INVERSE KINEMATICS

Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution. (12)

UNIT III: MANIPULATOR DIFFERENTIAL MOTION AND STATICS

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance. (12)

UNIT IV: PATH PLANNING

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning. (12)

UNIT V: DYNAMICS AND CONTROL

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. (12)

TEXT BOOKS:

REFERENCE BOOKS:

COURSE OBJECTIVES

- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To understand the fundamentals of number systems, Boolean algebra, Simplification of Boolean Function and Karnaugh map method.
- To understand the concepts of Combinational and Sequential Logic Design.
- To conceptualize the logic families and PLDs.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Design linear and non linear applications of OP – AMPS
- Design applications using analog multiplier and PLL
- Design ADC and DAC using OP – AMPS
- To implement number systems, Boolean algebra and Karnaugh map, Simplification method in the design of digital systems.
- Design and analyze Combinational and Sequential Logic Design and Programmable Logic Devices.
- Design and construct Combinational Logic circuits and Synchronous Sequential Circuits.

UNIT  I : FUNDAMENTALS OF ANALOG AND DIGITAL ELECTRONICS


UNIT II : SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, 566 Voltage Controlled Oscillator. PLL Functional Block diagram – Principle of operation, Applications: Frequency synthesis, DC Motor speed control.

IC VOLTAGE REGULATORS: Block diagram of 723 general purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting, Fixed and adjustable three terminal regulators. (12)


UNIT IV: COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN

COMBINATIONAL LOGIC DESIGN: Binary / BCD adders and subtractors, Decoders, Encoders, Multiplexers and Demultiplexers, Magnitude comparator, ALU.
SEQUENTIAL LOGIC DESIGN: Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration. Shift register, Binary counters, Ring counter, Johnson counter. Mealy/Moore state machines.

UNIT V: DIGITAL LOGIC FAMILIES AND PLDS
DIGITAL LOGIC FAMILIES - Characteristics of digital IC’s - TTL logic family – Totem pole, Open collector and tristate outputs. MOS transistor switches - nMOS Inverter / Logic gates, CMOS logic, Inverter / logic gates. ECL logic families – Comparison of performance of various logic families.

PROGRAMMABLE LOGIC DEVICES: Introduction to PLDs – ROM, PAL, PLA, FPGA, ASIC.

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To acquire a fundamental understanding of linear and digital control systems and their design.
- To understand the concepts of control system components and mathematical modeling of electrical system, mechanical system, etc.
- To study the concept of time response and frequency response of the system.
- An understanding of the concept of marginal stability, asymptotic stability and bounded-input bounded-output stability for continuous and discrete systems.
- To pioneer the basics of different plots such as Bode plot, Nyquist plot, Root locus method and Polar plot.
- To familiarize the theory of Z-transform, inverse Z-transform and their properties in the digital control system.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand and demonstrate discrete, digital, linear control systems.
- Explain sampling, quantization, encoding and their mathematical modeling.
- Explain effects of common non linearities introduced in a system.
- Understand Z transform, pulse transfer function and able to apply that concept for digital system analysis.
- Able to analyze digital system and non linear system stability using different analysis tools.

UNIT I: SYSTEM MODELING

Introduction to control system-Basic elements of control system- Open and Closed loop control systems-Differential equation representation of physical systems-Transfer function-Mathematical modeling of electrical and mechanical systems (Translational and Rotational)-Analogous system-Block diagram reduction techniques-Signal flow graph.

(12)

UNIT II: TIME DOMAIN ANALYSIS


(12)

UNIT III: FREQUENCY DOMAIN ANALYSIS

Frequency response-Frequency domain specifications- Correlation between time domain and frequency domain specifications-Bode plot- Stability analysis using Bode plot- transfer function from Bode plot-Polar plot-Analysis using MATLAB.

(12)

UNIT IV: STABILITY ANALYSIS AND ROOT LOCUS:


UNIT V : DIGITAL CONTROL SYSTEM

representation using physical, phase and canonical variables-diagonal canonical form-Jordan canonical form.

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the basic knowledge about kinematics of machines.
- To understand the basic components and layout of linkages in the assembly of a system/machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand the basic knowledge of kinematics of machines
- Students can able to apply fundamentals of mechanism for the design of new mechanisms
- Able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impart knowledge about the gears and gear trains.
- Ability to analyze them for optimum design

UNIT I: KINEMATIC OF MACHINES


(12)

UNIT II: GEARS and GEAR TRAINS


(12)

UNIT III: FRICTION

Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives.

(12)

UNIT IV: KINEMATICS OF CAM MECHANISMS


(12)

UNIT V: BALANCING AND VIBRATION


(12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To provide students with knowledge on the application of fluid power in process construction and manufacturing industries.
➢ To provide students with an understanding of the fluids and components utilized in modern industrial fluid power systems.
➢ To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Understand the Fluid power and operation of different types of pumps.
➢ Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.
➢ Understand the Different types of Hydraulic circuits and systems.
➢ Understand the working of different pneumatic circuits and systems.
➢ Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

UNIT I: FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS


UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS


UNIT III HYDRAULIC CIRCUITS AND SYSTEMS

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems. (12)

UNIT IV: PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS


UNIT V: TROUBLE SHOOTING AND APPLICATIONS

TEXT BOOKS:
3. 

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To supplement the design concepts in analog electronics.
➢ To understand how to design combinational and sequential circuits.

COURSE OUTCOMES

On successful completion of the module students will be able to:
➢ Ability to design linear integrated circuits and its applications
➢ Ability to design combinational and sequential circuits.

LIST OF EXPERIMENTS

1. Applications of Op-amp
   To study the application of Op-amp IC741 as
   a. Inverting amplifier
   b. Non-inverting amplifier
   c. Voltage follower
   d. Summer
   e. Subtractor

2. Differentiator and Integrator
   To study the op-amp performance as differentiator and integrator for various time constants

3. Comparator circuits and Signal converters
   a. To study zero crossing detector, window detector using Op-amp 741
   b. To study operation of op-amp as V to I and I to V converters

4. Data converters
   Construction and study performance of
   a. DAC circuits – R-2R and ladder type.
   b. Successive approximation type ADC.

5. Study of 555 Timer and 566 VCO.

6. Performance characteristics of Voltage Regulator ICs.

7. Design and implementation of the following Code convertors
   a. BCD to excess-3 code and vice versa
   b. Binary to gray code and vice-versa

8. Design of Multiplexers and Encoders

9. Design of Decoders and Demultiplexers

10. Shift register
    Study of a universal shift registers IC

11. Construction of Ring counter and Johnson counter using a shift register IC and study of their timing diagrams
COURSE OBJECTIVES
- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

LIST OF EXPERIMENTS:
1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass Moment of Inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
   b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.
    - Undamped and Damped Natural frequencies. b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
    b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using vibrating table.
COURSE OBJECTIVES

- To familiarize the fluid power automation and different components of Hydraulics, pneumatics, electro hydraulic/ electro pneumatic and PLC based systems
- Hands on experience in design and execution of circuits for real systems

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Explain the similarities and differences of the electrical, pneumatic and hydraulic systems, can decide which system is better for a specific application,
- Explain the basic parts of the industrial hydraulic and pneumatic systems and their functions, can design a hydraulic or pneumatic system circuit by using related software and make simulations,
- Design a hydraulic or pneumatic system and outline PLC control algorithm for a predefined automation process.

LIST OF EXPERIMENTS

1. Simulation of basic hydraulic, pneumatic and electrical circuits.
2. Study of Electro pneumatic circuits.
4. Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using ‘AUTOMATION STUDIO’ Software.
5. Study of various types of transducers.
6. Study of various signal conditioning circuits.
7. Open and closed loop control of AC and DC drives.
8. Study of PLC and its applications.
Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 45 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.
SEMESTER V

RA T51 - STATISTICS AND NUMERICAL METHODS

 COURSE OBJECTIVES

 This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
 To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
 To introduce the basic concepts of solving algebraic and transcendental equations.
 To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
 To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

 COURSE OUTCOMES

 Apply the concept of testing of hypothesis for small and large samples in real life problems.
 Apply the basic concepts of classifications of design of experiments in the field of agriculture.
 Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
 Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
 Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

UNIT I: TESTING OF HYPOTHESIS
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit. (12)

UNIT II: DESIGN OF EXPERIMENTS
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - factorial design. (12)

UNIT III: SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS

UNIT IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION
Lagrange’s and Newton’s divided difference interpolations – Newton’s forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules. (12)
UNIT V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS


TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the architectures and the instruction set of 8085, 8086, 8051
- To learn the assembly language program using 8085, 8086 and 8051 instruction set
- To learn interfacing of microprocessors and microcontrollers with various peripheral
- To introduce embedded systems, its hardware, software, devices and buses used for embedded networking.

COURSE OUTCOMES

On successful completion of this course students will be able to:

- Interpret the architecture & instruction set of 8085, 8086, 8051 microcontroller to develop assembly language programs
- Illustrate the application of 8051 microcontroller on chip peripherals to implement the functions of I/O port, timer/Counter, serial port & interrupts.
- Demonstrate the peripheral devices 8255 PPI and 8279 for integrating keyboard, 7 segment display, LCD display and traffic light controller & 8259 PIC for handling multiple interrupts I/O
- Design 8051 Microcontroller based systems for measuring electrical and physical quantities & Motor control. Interpret the hardware and software components of an embedded system for an application and infer the architecture and programming model of ARM processor.
- Infer the instruction set and exception types of ARM processor to develop Assembly language programs

UNIT I: INTEL 8085 MICROPROCESSOR


UNIT II: ON-CHIP PERIPHERALS & PERIPHERAL DEVICES

I/O Port Programming - Timer Registers - Timer Modes - Overflow Flags - Clocking Sources - Timer/Counter Interrupts – Timer Programming - Baud Rate Generation - Serial Port Register - Modes of Operation - Serial Port Programming- Interrupt Organization- Processing Interrupts - Interrupt Programming- Programmable Peripheral Interface (8255) - Keyboard / Display Controller (8279) - Programmable Interrupt Controller (8259). (12)

UNIT III: DESIGN OF MICROCONTROLLER BASED SYSTEM


UNIT IV: EMBEDDED SYSTEMS & ARCHITECTURE OF ARM PROCESSOR

Processor Embedded into a system - Embedded Hardware units and devices in a system - Embedded Software in a System - Classification of Embedded Systems - Embedded Design Life Cycle - Design Example: Model Train Controller. ARM Embedded System - CISC and RISC Processors - ARM Architecture - Programming Model - Operating Modes. (12)

UNIT V: ARM PROGRAMMING

ARM Instruction Set - ARM Instruction Types: Data Transfer, Data Processing and Control Flow Instructions - Interrupts – Exceptions types - NVIC Registers for interrupt control. (12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To provide knowledge levels needed for PLC programming and operating.
- To make the students understand how devices are connected with PLC input and output modules.
- To train the students to create ladder diagrams from process control descriptions.
- To make the students understand various types of PLC registers
- Apply PLC Timers and Counters for the control of industrial processes
- To make the students understand PLC functions, Data Handling Function
- To train the students to develop a --coil and contact control system to operate a basic robot and analog PLC operations.

COURSE OUTCOMES

Ability to gain knowledge on Programmable Logic Controllers
- The students will learn about the design of systems using Programmable Logic Controllers
- To know about the different applications of Programmable Logic Controllers
- Will understand different types of Devices to which PLC input and output modules are connected
- To provide the knowledge about understand various types of PLC registers
- Able to create ladder diagrams from process control descriptions.
- Ability to apply PLC timers and counters for the control of industrial processes
- Able to use different types PLC functions, Data Handling Function.
- Able to develop a —coil and contact control system to operate a basic robot and analog PLC operations.

UNIT I: INTRODUCTION TO FACTORY & PROCESS AUTOMATION
Industrial Versions - Control elements of Industrial Automation- IEC/ ISA Standards for Control Elements – Selection criteria for control elements- Construction of Relay Ladder logic with different control elements- Need for PLC - PLC evolution. (12)

UNIT II: PROGRAMMABLE LOGIC CONTROLLERS
Architecture of PLC - Types of PLC – PLC modules, PLC Configuration -Scan cycle - Capabilities of PLC- Selection criteria for PLC – PLC Communication with PC and software- PLC Wiring- Installation of PLC and its Modules. (12)

UNIT III: PROGRAMMING OF PLC
Types of Programming – Bit Instructions -Timers and counters– PLC arithmetic functions PTO / PWM generation- High Speed Counter – Analog Scaling – Encoder Interfacing- Servo drive control – Stepper Motor Control. (12)

UNIT IV: HMI SYSTEMS
Need for HMI in Industrial Automation, Types of HMI – Configuration of HMI, Screen development and navigation, Configuration of HMI elements / objects and Interfacing with PLC. (12)

UNIT V: NETWORKING
TEXT BOOKS:
2. Frank D Petruzella, -Programmable logic controllersl, McGraw-Hill, 5th Ed, 2016..

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To introduce the overview of robotic systems and their dynamics
➢ To impart knowledge on system stability
➢ To acquire knowledge on joint space and task space control schemes
➢ To understand the concept of nonlinear control and observer schemes

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Understand basic concept of robotic systems and their dynamics.
➢ Analyze system stability and types of stability
➢ Know about joint space and task space control schemes
➢ Understand the concept of nonlinear control and observer schemes

UNIT I: INTRODUCTION AND OVERVIEW OF ROBOTIC SYSTEMS AND THEIR DYNAMICS

Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes. (12)

UNIT II: SYSTEM STABILITY AND TYPES OF STABILITY

Lyapunov stability analysis, both direct and indirect methods. Lemmas and theorems related to stability analysis. (12)

UNIT III: JOINT SPACE AND TASK SPACE CONTROL SCHEMES

Position control, velocity control, trajectory control and force control. (12)

UNIT IV: NONLINEAR CONTROL SCHEMES

Proportional and derivative control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer based control, robust control and optimal control. (12)

UNIT V: NONLINEAR OBSERVER SCHEMES:

Design based on acceleration, velocity and position feedback. Numerical simulations using software packages namely MATLAB/MATHEMATICA. (12)

TEXT BOOKS:


2. A Sabanovic and K Ohnishi, —Motion Control Systems‖, John Wiley & Sons (Asia), 2011

3. 

REFERENCE BOOKS:


COURSE OBJECTIVES
- Understand evolution and principle of CNC machine tools
- Write simple programs for CNC turning and machining centres
- Generate CNC programs for popular CNC controllers
- Describe about linear and angular measurements in metrology
- Study the advancement in metrology

COURSE OUTCOMES
On successful completion of the module students will be able to:
- To understand about the basic in CNC machineries
- Understand Evolution and principle of CNC machine tools and different measurement technologies. Able to write simple programs for CNC machinery
- Impart knowledge about linear and angular measurements in metrology
- Know about the advancement in metrology

UNIT I: INTRODUCTION TO CNC MACHINE TOOLS
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection, CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways. (12)

UNIT II: DRIVES AND WORK HOLDING DEVICES
Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives – stepper motor, servo principle, DC and AC servomotors, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosyn, laser interferometer, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines. (12)

UNIT III: CNC PROGRAMMING
Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages. (12)

UNIT IV: LINEAR AND ANGULAR MEASUREMENTS

UNIT V: ADVANCES IN METROLOGY

TEXT BOOKS:

REFERENCE BOOKS:

COURSE OBJECTIVES
➢ To enable the students to program, simulate and test the 8085, 8051, PIC 18 and ARM processor based circuits and their interfaces
➢ Introduce students to embedded systems design tools and hardware programmers

COURSE OUTCOMES
Upon completion of this course the students will be able to
➢ Develop 8051 Assembly Language Programs for Arithmetic, Logic, Bit manipulation, String operations and
➢ Demonstrate an application for 8051 microcontroller using Traffic light controller, ADC & DAC interfacing boards
➢ Demonstrate 8051 Embedded C Coding for Programming the GPIO, Timer, Interrupts & Serial Port and a system for
g➢ temperature monitoring using Arduino target Board
➢ Develop communication skills and capability to work in team

LIST OF EXPERIMENTS:
Microcontroller Lab:
Developing Assembly Language Programs using 8051 Microcontroller Kits
➢ Data manipulating Operations and Delay Routines
➢ String operations
➢ Interfacing Traffic light controller
➢ Interfacing ADC
➢ Interfacing DAC

Embedded Laboratory
1. Voltage Measurement with display
   Designing a voltmeter to measure voltage from 0 to 5 volts and displaying the measured value using 7 segment displays
2. Design of Water Pump Controller to sense the water level in a tank
3. Digital Clock with LCD display
4. Temperature Measurement with 7 segment display
5. PC Communication
   Interfacing the microcontroller to a PC through RS232 interface and displaying the messages sent by the microcontroller on the PC using Visual Basic program running in PC
6. Remote Control through FM Link
   Establishing an FM link between two microcontrollers for data transfer.
7. Hot Chamber Controller to maintain the temperature at the set point.
8. Obstacle Detector using ultrasonic transmitter- receiver
9. Moisture sensor and sprinkler controller design
10. Designing a lamp controller having a light sensor and a timer
COURSE OBJECTIVES
To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations.
- Understanding the wiring diagram interfacing with I/O elements.
- Design and development of ladder diagrams for various applications.
- Interfacing and programming for motor control using PLC

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Development of ladder logic diagram using Bit Instructions.
- PLC based Crane control.
- PLC based parking station using Counter and Bit Instructions.
- Analog Sensor interfacing with PLC.
- Encoder interfacing with PLC.
- Stepper motor / Servo motor control using PLC
- Upon Completion of the course, the students will be able to use of any robotic simulation software to model the different types of robots and calculate work volume for different robots

LIST OF EXPERIENCES:
PLC
1. Development of ladder logic diagram using Bit Instructions.
2. PLC based Crane control.
3. PLC based parking station using Counter and Bit Instructions.
4. Analog Sensor interfacing with PLC.
5. Encoder interfacing with PLC.
6. Stepper motor / Servo motor control using PLC.

ROBOTICS
1. Forward and Inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT.
2. Forward and Inverse kinematics to control hand movements in NAO.
3. Study and selection of Gripper.
4. Implementation of trajectory planning algorithm for straight line motion using Matlab and executing PID based control of two axis planar articulated robot in Lego NXT.
COURSE OBJECTIVES

➢ To impart knowledge in CNC programming for turning and milling operations
➢ To use measuring systems for the geometrical measurements of gears and threads.
➢ To know the measurement of Taper Angle using Sine Bar

COURSE OUTCOMES

On successful completion of the module students will be able to:

➢ Ability to understand the features and operation of CNC machines.
➢ Ability to prepare CNC program from the component drawings
➢ Understanding the usage of profile projectors and tool makers microscopes.

LIST OF EXPERIMENTS:

1. Study of the CNC machine
2. Programming and simulation of a lathe using any CAM package
3. Programming and simulation of a machining centre using any CAM package
4. Programming and operation of a CNC Lathe
5. Programming and operation of a CNC machining centre
6. Measurement of Taper Angle using Sine Bar
7. Optical profile projector – study of profile of gear tooth, screw threads.
8. Tool maker’s microscope – to study cutting tool geometry, screw threads.
9. Tool wear and surface finish measurement.
10. Dimensional measurement of machined components using, bore gauge, air gauge and Height master.
COURSE OBJECTIVES

- The course aims to: Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates.
- Develop their confidence and help them attend interviews successfully.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- At the end of the course Learners will be able to:
- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

UNIT I: ART OF COMMUNICATION


UNIT II: INTRODUCTION TO SOFT SKILLS


UNIT III: WRITING


UNIT IV: SPEAKING PRACTICE


UNIT V: APTITUDE

Verbal and Numerical aptitude.

REFERENCE BOOKS:

COURSE OBJECTIVES

- To provide an overview of how computers are being used in mechanical component design with the use of various CAD standards
- To introduce the concepts of Mathematical Modelling of Engineering Problems using FEM with 2D scalar and vector variables problems respectively.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- know the basic concepts of modelling and assembly for different mechanical components
- know the different types of CAD standards used in modeling of mechanical components
- know about basic concepts of FEA and analysis software for analyzing mechanical components
- know about different mathematical techniques used in finite element analysis to solve structural and thermal problems

UNIT I: MODELLING AND ASSEMBLY

Assembly modelling – Interferences of positions and orientation – Tolerance analysis-Mass property calculations – Mechanism simulation and interference checking. (12)

UNIT II: CAD STANDARDS

Standards for computer graphics- Graphical Kernel System (GKS) - Standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards. (12)

UNIT III: INTRODUCTION TO ANALYSIS

Basic concepts of the Finite Element Method - Discretization - Meshing – Mesh refinement- Mesh Enrichment- Natural co-ordinate systems - Types of elements- Special Elements- Crack tip Element- Introduction to Analysis Software. (12)

UNIT IV: TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS


UNIT V: TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements. (12)

TEXT BOOKS:


REFERENCE BOOKS

COURSE OBJECTIVES

- To understand the basic knowledge about kinematics of machines.
- To understand the basic components and layout of linkages in the assembly of a system/machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand the basic knowledge of kinematics of machines
- Apply fundamentals of mechanism for the design of new mechanisms
- Know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impart knowledge about the gears and gear trains.
- Analyse them for optimum design.

UNIT I: INTRODUCTION

Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots. (12)

UNIT II: DIRECT &INVERSE KINEMATICS

Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link coordinates, D-H Representation, Arm equation -Two axis, three axis, four axis, five axis and six axis robots. Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots. (12)

UNIT III: WORKSPACE ANALYSIS

Workspace analysis of Four axis, Five axis and Six axis robots, Perspective transformation, structured illumination, Camera calibration, Work envelope of Four and Five axis robots, Workspace fixtures. (12)

UNIT IV: DIFFERENTIAL MOTION AND STATICS

The tool Configuration jacobian matrix for three axis and, four axis robots, joint space singularities, resolved motion rate control, manipulator jacobian for three and four axis joint space singularities, induced joint torques and forces. (12)

UNIT V: DYNAMIC ANALYSIS AND FORCES

Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot. Trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straightline motion. (12)

TEXT BOOKS:

REFERENCE BOOKS:

COURSE OBJECTIVES
- To acquire the knowledge on advanced algebraic tools for the description of motion.
- To analyze and design the motion for articulated systems.
- To develop an ability to use software tools for analysis and design of robotic systems.

COURSE OUTCOMES
On successful completion of the module students will be able to:
- Understand the matrix algebra and Lie algebra for computing the kinematics of robots
- Analyze the forward kinematics and inverse kinematics of serial and parallel robots
- Do the path planning for a robotic system

UNIT I: BASICS OF ROBOTICS

UNIT II: DESIGNING CHEFBOT HARDWARE
Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad - Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators. (12)

UNIT III: WORKING WITH ROBOTIC SENSORS
Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit. (12)

UNIT IV: PYTHON AND ROS
Introduction to OpenCV, OpenNI, and PCL - Programming Kinect with Python using ROS, OpenCV, and OpenNI - Working with Point Clouds using Kinect, ROS, OpenNI, and PCL. (12)

UNIT V: INTERFACING IT INTO ROS, USING PYTHON

TEXT BOOKS:

REFERENCE:
COURSE OBJECTIVES
 To know about the basic concepts in industrial automation
 To design automated systems.
 To know about transfer lines and automated assembly
 Be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
 To know about the advancement in hydraulics and pneumatics

COURSE OUTCOMES
 Knowledge of industrial automation by transfer lines and automated assembly lines.
   Ability to design an automated system.
 Understanding of automated controls using pneumatic and hydraulic systems.
 Ability to understand the electronic control systems in metal machining and other manufacturing processes.
 To understand advancement in hydraulics and pneumatics systems.

UNIT I: FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION
Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Selection of motor for automation system, sizing of servo motor for a specific application, importance of sizing, selection of mechanical components, load cycle definition, load inertia and torque calculations, selection of motors. (Motion control in Automation) (12)

UNIT II: TRANSFER LINES AND AUTOMATED ASSEMBLY
General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing. (12)

UNIT III: DESIGN OF MECHATRONIC SYSTEMS FOR MATERIAL HANDLING APPLICATIONS:
Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system, belt conveyor elements, selection of belt, drive, greasing of idlers, Plow Vs Trippers, magnetic pulley, skirt boards, training of belt conveyors, weighing material in motion, shuttle belt conveyor, pinion –swivel arrangement, troughing, suspended idlers, belt cleaners, transfer of material from belt to belt, cover, safety protection at pulleys, belt speeds and widths, design of a belt conveyor, belt conveyor calculation, minimum pulley diameters, enclosures for conveyors, idler selection, conveyor belt troubles. (12)

UNIT IV: PROGRAMMABLE AUTOMATION
Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems. CNC architecture for intelligent machine tool – case study – CNC machine parts and working with block diagram. (12)
UNIT V: DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To introduce students to the design and theory of common machine elements and to give students experience in solving design problems involving machine elements.

COURSE OUTCOMES

Upon completion of this course, the students can able

- Formulate and analyze stresses and strains in machine elements subjected to various loads.
- Analyze and design structural joints such as Riveted joints, welded joints, Bolts.
- Analyze and design the components for power transmission like shaft and couplings.
- Analyze and design different types of gears and belts for engineering applications.
- Analyze and design structural joints such as Riveted joints, welded joints, Bolts.

UNIT I: DESIGN OF GEARS

Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair. (12)

UNIT II : DESIGN OF SHAFTS AND COUPLINGS

Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and rigidity – Couplings, types and applications, design of rigid and flexible couplings – Keys, types and applications, Design of keys. (12)

UNIT III: BELTS AND CHAINS

Belts -Types and application, selection of flat, V-belts, and Timing belt for given power and velocity ratio. Selection of roller chain and power speed ratio, silent chain. (12)

UNIT IV : ROLLING CONTACT BEARINGS

Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings. (12)

UNIT V: FRICTION DRIVES

Clutches, role of clutches, principle of operation of clutch, classification of clutches, friction materials for clutches, design of single plate and multiple plate clutches- Case studies of Conveyor Design, case study on integrated conveyor belt model for mining Industry. (12)

TEXT BOOKS:


REFERENCE BOOKS:

COURSE OBJECTIVES

➢ To expose the students to the usage of Solid Modeling, Ansys, Adams, Delmia and CAD/CAE softwares for modeling and analysis purposes.

COURSE OUTCOMES:

➢ Exposed to use CAD softwares for modeling of machine components.
➢ Exposed to use softwares for mechanism analysis.
➢ Knowledge in conducting crash/impact analysis using FEA.

LIST OF EXPERIMENTS:

1. Solid modeling of engineering components and assembly.
2. Determination of stresses and factor of safety in critical machine components by FEM and experimental validation of the results by strain measurement.
3. Dynamic analysis of chassis frame of an automobile.
5. Kinematic and dynamic analysis of mechanisms using mechanism Ansys software.

REFERENCE BOOKS:

COURSE OBJECTIVES
- To illustrate the design and simulation of multiple actuator systems using pneumatic, electro-pneumatic and PLCs and enable the students to integrate various fringe conditions in multiple actuator systems.
- To design a system using PNEUMOSIM software
- To design a Microcontroller kit with stepper motor and drive circuit using LABVIEW software
- To expose the students in sensors/actuators interfaced with computers.
- To design a circuit using stepper motor

LIST OF EXPERIMENTS
1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
COURSE OBJECTIVES
➢ Introduce the programming technique with instrument interfaces and applications of virtual instruments and to understand the basics of data acquisition are introduced in Robotics and Automation systems.

COURSE OUTCOMES
➢ Understand the evolution, advantages, techniques, architecture and applications of visual instrumentation
➢ Acquiring knowledge on VI programming techniques
➢ Study about the basics of data acquisition
➢ Understanding the concept of common instrument interfaces with industrial applications
➢ Study about the use of analysis tools with various applications

LIST OF EXPERIENCES
1. Creating Virtual Instrumentation for simple applications
2. Programming exercises for loops and charts
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time sequential control of any batch process.
COURSE OBJECTIVES
- To enable the learner to communicate effectively and appropriately in real life situation
- To use English effectively for study purpose across the curriculum;
- To develop interest in and appreciation of Literature;
- To develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking and Writing;
- To revise and reinforce structure already learnt.

COURSE OUTCOMES
At the end of the course Learners will be able to:
- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

UNIT I: COMPOSITION ANALYSIS

UNIT II: WRITING
Job Application Letter Writing – Resume Writing

UNIT III: ORAL SKILLS
Group Discussion – Introduction and Practice – Team Work – Negotiation Skills – Organizing and Attending Meetings – Facing Interviews

UNIT IV: ADAPTING TO CORPORATE LIFE
Corporate Etiquette – Grooming and Dressing

UNIT V: APTITUDE
Verbal and numerical aptitude

REFERENCE BOOKS:
1. Pushplata and Sanjay Kumar, Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews, PHI Learning, Delhi, 2007.
SEMESTER VII

RA T71 INDUSTRIAL ROBOTICS & MATERIAL HANDLING 4 0 0 4

COURSE OBJECTIVES

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To know about material handling in a system.

COURSE OUTCOMES

The Student must be able

- Learn about the basic concepts, parts of robots and types of robots.
- To design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.
- Ability in selecting the required robot
- Know various applications of robots
- Apply their knowledge in handling the materials.

UNIT I: INTRODUCTION

Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, machine loading and unloading, CNC machine tool loading, Robot centered cell. (12)

UNIT II: ROBOTS FOR INSPECTION

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations. (12)

UNIT III: OTHER APPLICATIONS

Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications. (12)

UNIT IV: END EFFECTORS

Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers. SELECTION OF ROBOT: Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society. (12)

UNIT V: MATERIAL HANDLING

Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology. Introduction to Automation Plant design softwares. (12)
TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES
- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence.

COURSE OUTCOMES
Upon successful completion of this course student will:
- To understand the basics of Artificial Intelligence, Intelligent Agents and its structure
- To understand the problem solving by various searching techniques
- To understand the concept of informed search and Exploration
- To understand the concept of constraint satisfaction Problems and Adversarial Search
- To Understand what is Reasoning and Knowledge Representation
- To understand the concept of Reasoning with Uncertainty & Probabilistic Reasoning
- To Understand the basic forms of Machine Learning, decision trees and statistical Learning setting

UNIT I: INTRODUCTION
History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching – Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning–knowledge representation – first order logic. (12)

UNIT II: PLANNING
Planning withforward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world. (12)

UNIT III: REASONING

UNIT IV: LEARNING
Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception. (12)

UNIT V: AI IN ROBOTICS
Robotic perception, localization, mapping–configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics. (12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and their applications.
- To know about the basic in SCADA and DCS systems.
- To gain knowledge in communication protocols in an integrated system.
- To know about the advanced in automation industries.

COURSE OUTCOMES

- Knowledge of PLC & PAC automation.
- Ability to apply SCADA and usage of C programming for report generation.
- Acquiring information’s on communication protocols in automation systems.
- Ability to design and develop automatic control system using distributed control systems.
- Knowledge in automation of industries.

UNIT I: TOTALLY INTEGRATED AUTOMATION

Need for TIA - TIA Architecture - Components of TIA systems - Selection of TIA Components – Programmable Automation Controllers (PAC) - Vertical Integration structure. (12)

UNIT II: SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)


UNIT III: COMMUNICATION PROTOCOLS OF SCADA


UNIT IV: DISTRIBUTED CONTROL SYSTEMS (DCS):


UNIT V: INDUSTRIAL PLANT DESIGN


TEXT BOOKS:

COURSE OBJECTIVES
- To develop student’s skills in perform kinematics analysis of robot systems
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control.

COURSE OUTCOMES
After the successful completion of this course, the student will be able to:
- Select & identify suitable automation hardware for the given application.
- Describe & explain potential areas of automation.
- Differentiate various control aspects of automation.
- Demonstrate the self learning capability of Industrial Automation.

LIST OF EXPERIMENTS:
1. Design of conveyor automation system using PLC, SCADA and Electrical drive.
2. Design of inspection automation system using sensors, PLC, HMI/SCADA.
3. Sizing and Selection of industrial power and automation cable for a typical application.
4. Design of simple water management system using PLC, SCADA and Electrical drive.
5. Design of simple power system automation.
6. Design and Simulation of process automation using CIROS.
7. Simulation of robotic system using CIROS.
Students have to do design a Mechatronic product based on the given topic. It includes modeling, simulation, and design of a particular product.
The students are required to undergo in plant training for a period of two weeks /four industrial visits during the summer vacation after the fourth semester. Each student has to submit a detailed report on the training programme undergone. Each student will be evaluated by an internal assessment committee (comprising of the Head of the Department and two faculty members) for a total of 50 marks.
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.

COURSE OUTCOMES

➢ 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.

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester. In the phase I of the project work, the progress of the work carried out in the 7th semester will be monitored and assessed internally for a total of 50 marks. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment.
COURSE OBJECTIVES

➢ To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

COURSE OUTCOMES

➢ Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

The course should covered the following topics by way of Seminars, Expert Lectures and

ASSIGNMENTS

Engineering Ethics—Moral issues, Ethical theories and their uses Engineering as Experimentation—Code of Ethics Engineer’s responsibility for safety Responsibilities and rights Global issues of engineering ethics

REFERENCE BOOKS

COURSE OBJECTIVES
➢ To impart knowledge in maintenance
➢ To know about the fundamentals of maintenance and to implement it.
➢ To study about safety engineering practices.
➢ To analyze the hazards in protection.
➢ To know about the safety in machine operation.

COURSE OUTCOMES
➢ Maintain the industry without any risk in its operation. Improve the production
➢ Analyze the hazards in maintenance and to solve it.
➢ Identify and prevent chemical, environmental mechanical, fire hazard through analysis
➢ Apply proper safety techniques on safety engineering and management

UNIT I: MAINTENANCE
Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure.

UNIT II: TOTAL PRODUCTIVE MAINTENANCE
Principles; preparatory stages of implementation – TPM organisation structure, creation; basic TPM policies and aids, master plan. TPM IMPLEMENTATION: Small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program.

UNIT III: SAFETY SYSTEMS ANALYSIS
Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations.

UNIT IV: HAZARD ANALYSIS

UNIT V: SAFETY IN MACHINE OPERATION

TEXT BOOKS:
REFERENCE BOOKS:
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.

COURSE OUTCOMES

➢ 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.

Extension and completion of project work started in the previous semester. On completion of the project work, each student has to prepare a project report and submit the same to the department. In the Phase II, the project work and the report will be evaluated by the internal assessment committee by conducting two reviews and one demo for a total of 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.
LIST OF ELECTIVES
SEMESTER V – ELECTIVE I

RA E01 - VLSI DESIGN

COURSE OBJECTIVES
➢ To introduce Digital VLSI design concepts and to introduce IC designing using Field Programmable Gate Arrays.
➢ To impart skill set in VHDL Hardware Description Language and understand real time modeling of ICs with test benches.

COURSE OUTCOMES
➢ Foundational skill set in CMOS technology and logic implementation using CMOS.
➢ Basics of VHDL hardware description language and VHDL levels of abstraction.
➢ Working knowledge of VHDL programming using concurrent architecture.
➢ Designing complex digital systems using component instantiation.
➢ Working knowledge of test bench development.

UNIT I: CMOS TECHNOLOGY
Introduction to MOS transistors and VLSI fabrication (NMOS, PMOS, CMOS and BiCMOS)- Introduction to power reduction techniques-Dynamic Power Reduction-Static Power Reduction- NMOS and CMOS inverter- Determination of pull up to pull down ratios – propagation delays – power dissipation Stick Diagram -MOS layers - Design rules and layout- choice of layers and Scaling. (12)

UNIT II: COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN
Pass transistor and transmission gates-Inverter-NAND gates and NOR Gates for n MOS, CMOS and Bi CMOS – parity generator – Multiplexers- code converters – Programmable Logic Devices (nMOS PLA and CMOS PLA) – Clocked sequential circuits – D-Latch and D- Flip- Flop –Memories (DRAM cell, SRAM Cell and Pseudo Static RAM cell) – Inverting and Non-Inverting Registers – Barrel Shifter. (12)

UNIT III: SUBSYSTEM DESIGN

UNIT IV: CMOS TESTING

UNIT V: INTRODUCTION TO VERILOG:
Basics of Verilog, operators, Data Types, Continuous assignments, Sequential and parallel statement groups. Timing control (level and edge sensitive) and delays, tasks and functions, control statements, Blocking &non blocking assignments, If-else and case statements, For-while-repeat and forever loops, Rise, fall, min, max delays, Behavioural and synthesizable coding styles for modelling combinational logic, Behavioural& synthesizable coding styles.
for modelling sequential logic.

**TEXT BOOKS:**

**REFERENCE BOOKS:**
COURSE OBJECTIVES

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems.
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

COURSE OUTCOMES

- The students will be able to understand neural network, fuzzy logic and its application and neuro fuzzy controller.

UNIT I: ARTIFICIAL NEURAL NETWORK

UNIT II: NEURAL NETWORKS FOR MODELING AND CONTROL

UNIT III: FUZZY SET THEORY
Fuzzy set theory- Fuzzy sets- Operation on fuzzy sets- Scalar cardinality, Fuzzy cardinality, union and intersection- complement (Yeger and sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation- fuzzy membership functions. (12)

UNIT IV: FUZZY LOGIC FOR MODELING AND CONTROL

UNIT V: HYBRID CONTROL SCHEMES

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- Basic knowledge about networking in industries.
- Understand the evolution of computer networks using the layered network architecture.
- Understand the concepts of data communications.
- Be familiar with the Transmission media and Tools.
- Design computer networks using sub-netting and routing concepts.

COURSE OUTCOMES

At the end of the course, the student should be able to:

- Apply the concepts of data communications and to design computer networks using subnetting and routing concepts.
- Compare the various medium access control techniques.
- Compare and contrast the characteristics of physical layer.
- Analyze the different protocols.
- Compare and contrast the different network components.

UNIT I: INTRODUCTION


UNIT II: COMMUNICATION BUS PROTOCOLS


UNIT III: ETHERNET SYSTEMS

IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigabit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet. (12)

UNIT IV: WIRELESS COMMUNICATIONS

UNIT V: APPLICATIONS

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study about the localization, planning and navigation.
- To study the control of robots for some specific applications.
- To study about the humanoid robots.

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

- Explain the basic concepts of working of robot.
- Analyze the function of sensors in the robot.
- Developing programs to use a robot for a typical application.
- Use Robots in different applications.
- Know about the humanoid robots functions & its operations.

UNIT I: INTRODUCTION


UNIT II: LOCALIZATION


UNIT III: PLANNING AND NAVIGATION

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance - Case studies: Tiered robot architectures.

UNIT IV: FIELD ROBOTS

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, Civilian and military applications, Nuclear applications, Space applications.

UNIT V: HUMANOIDS


TEXT BOOKS:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots”, Bradford Company Scituate, USA, 2004

REFERENCE BOOKS:
COURSE OBJECTIVES
To study the TC3 functions and types of connectivity used in Industrial automation.

COURSE OUTCOMES
After the successful completion of this course, the student will be able to:
- Study TwinCAT Introduction & Licensing.
- Apply TC3 functions in Matlab/LabVIEW/Simulink
- Learn the various types of connectivity used in Automation
- Implement the techniques in hardware platform.

UNIT I: INTRODUCTION

UNIT II: TC3 FUNCTIONS
Measurement Control-Motion - Motion Axis Configuration - NC PTP - NCI - TwinCAT Kinematic transformation-Stepper Motor & Drive terminal Configuration - C/C++ - Matlab/LabVIEW/Simulink - I/O - Safety PLC.

UNIT III: CONNECTIVITY
Serial Communication - RS232, RS485/RS422, MODBUS RTU, CANOpen, ProfiBus, DeviceNet - Database Server - SMS/SMTP - TCP/IP.

UNIT IV :BUILDING AUTOMATION

UNIT V: LAB SESSION
1. TwinCAT Software and Hardware
2. NC PTP Programming
3. Motion Control programming with kinematic transformation
4. Communication programming
5. Building automation system integration

TEXT BOOKS:

REFERENCE:
https://infosys.beckhoff.com
SEMMESTER VI – ELECTIVE II

RA E06  IMAGE PROCESSING AND VISION SYSTEMS  4 0 0 4

COURSE OBJECTIVES

➢ To represent and interpret image in its numeric and graphical form.
➢ To understand geometric relationship of pixels.
➢ To write simple codes for improving image quality.
➢ To extract useful information from image contents through processing.
➢ To understand and document needs for specific machine vision system.
➢ To develop machine vision system based on requirement.

COURSE OUTCOMES

After successful completion of the course, student will be able to

➢ Represent and interpret image in its numeric and graphical form.
➢ Understand geometric relationship of pixels.
➢ Write simple codes for improving image quality.
➢ Extract useful information from image contents through processing.
➢ Understand and document needs for specific machine vision system.
➢ Develop machine vision system based on requirement.

UNIT I: VISION SYSTEM


UNIT II: LOW-LEVEL VISION:

Image representation – Gray level transformations, Histogram equalization, Image subtraction, Image averaging – Filters: Smoothing spatial filters, sharpening spatial filters, smoothing frequency domain filters, sharpening frequency domain filters - Edge detection. (12)

UNIT III: HIGHER-LEVEL VISION:

Segmentation: Edge linking and Boundary Detection, Thresholding, Region-oriented segmentation, the use of motion – Description: Boundary Descriptors, Regional Descriptors, Recognition: Decision-Theoretic methods, structural methods. (12)

UNIT IV: APPLICATIONS:

Camera Calibration - Stereo Imaging - Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic Image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering, Kalman Filtering. (12)

UNIT V: ROBOT VISION

Basic introduction to Robotic operating System (ROS) - Installing and testing ROS camera Drivers, ROS to OpenCV - The cv bridge Package. Introduction to OpenCV image processing library and MATLAB programming. (12)
TEXTBOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
- To learn the algorithms and models developed in MATLAB, simulink into VHDL for implementing in PLD and also realize the concept of interfacing.

COURSE OUTCOMES
- Acquire knowledge about programmable logic devices.
- Extrapolate various programming languages to develop digital designs for implementation in either a processor or in PLD.
- Generalize with VHDL to simulate and synthesize the digital design.
- Implement combinational logic, sequential logic using VHDL and acquire knowledge about state machine design, memories.
- Translate algorithms and models developed in MATLAB, simulink into VHDL for implementing in PLD and also realize the concept of interfacing.

UNIT I: INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES
Introduction to the programmable logic devices, comparison of programmable logic with digital logic and processors - Types of programmable logic, Simple Programmable Logic Device (SPLD), Complex Programmable Logic Device (CPLD), Field Programmable Gate Array (FPGA)- PLD configuration technologies- Programmable logic design methods and tools, Technology trends. (12)

UNIT II: DESIGN LANGUAGES
Introduction to various software programming languages: C, C++, Java, Visual basics, scripting language, PHP- Hardware description language, VHDL description for two input and gate- Hardware description language, Verilog HDL description for full adder- Hardware description language, Verilog description for voltage amplifier- Introduction to mathematical modeling tools, modeling of motor control system using simulink. (12)

UNIT III: DIGITAL LOGIC DESIGN WITH VHDL
Designing with high definition language- Design entry methods- Logic synthesis- Entities, architectures, packages and configurations- Coding styles for VHDL. (12)

UNIT IV: COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN
Introduction to combinational logic design, VHDL design for adders and four to one multiplexer- Encoder design using VHDL- Introduction to sequential logic design and VHDL design for D-latch- Design of binary counter using VHDL- Introduction to state machine design, design of sequence detector using VHDL- VHDL design of memories: RAM, ROM- Testing of VHDL design. (12)

UNIT V: SYSTEM LEVEL DESIGN
Creating VHDL test bench for digital to analog converter- Creating VHDL test bench for thyristor gate control pulse-generator- Electronic system level design- Creating VHDL test bench for digital filter design. (12)
TEXT BOOKS

REFERENCE BOOKS
COURSE OBJECTIVES
Analysis and application of load control techniques in Industries.

COURSE OUTCOMES
- Acquire knowledge about load control techniques in industries and its application.
- Acquire knowledge about load management to reduce demand of electricity during peak time.
- Analyse and understand different energy saving opportunities in industries.
- Acquire knowledge about reactive power control in industries and analyse different power factor improvement methods.
- Learn mathematical modelling and profiling of various loads such as cool storage, cooling and heating loads.

UNIT I: INTRODUCTION
Construction and Principle of operation of PMSM and SynRM – AC drive Hardware Blocks – Control Blocks – Automatic Motor Adaptation – Parameterization of Drives (Local and Remote). (12)

UNIT II: CONFIGURATIONS OF DIFFERENT I/O CONTROL
Digital Input and output – Analog Input and output Control -word access – Motion control - Sequential Logic Control (SLC) - Parameterization for different communication protocol: RS 485 – MODBUS - PROFIBUS. (12)

UNIT III: CONFIGURATION FOR DIFFERENT APPLICATIONS
AQUA – HVAC – Automation – Master/ Slave control. (12)

UNIT IV: PRACTICAL
Performance characterization of PMSM and SynRM - Conveyor control – Cascaded Pump Control – Synchronization of Drives with Master Slave Control. (12)

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES

- This course attempts to address the applications of robots in some specific areas where the use of robots have significantly improved productivity.

COURSE OUTCOMES

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

- Understand the various types of Industrial, field and service Robots and their characteristics and capabilities.
- Equip with the knowledge of Mathematical modeling of specialized Robots.
- Familiarize with the operation of Robots and processes involved.
- Select the right Robot with required configurations and specifications for applications.
- Familiarize with the applications of various field and service Robots.

UNIT I: APPLICATIONS OF ROBOTS IN INDUSTRIES

Introduction to robotics - overview, A short history of industrial Robots - Applications of Robots in Welding, car body assembly, painting- Applications of Robot in Machining, material transfer- Kinematics and mechanisms review, tasks descriptions, teaching and programming- End-effectors and system integration. (12)

UNIT II: COOPERATIVE AND SWARM ROBOTS

Cooperative manipulation, Challenges in cooperative manipulation- Case studies for Cooperative manipulation for Industrial and Service applications- Introduction to swarm Robots, comparison with other multi-agent systems, challenges and benefits of swarm systems- Algorithms for swarm Robots, application, case study of swarm Robots. (12)

UNIT III: FIELD ROBOTICS

Forestry, Robot locomotion, forestry automation, SLAM in forestry- autonomous Robots for silviculture and treatment- Broad acre Applications: Automatic guidance, sowing, weeding, spraying and broad-acre harvesting, Horticulture: picking of fruits- Robot milking, sheep shearing, slaughtering, livestock inspection- Robots in construction, unsolved problems in construction, Future directions- Robots for hazardous applications, enabling technologies- Search and Rescue robotics: Disaster characteristics-Impact on Robots, Robots actually used at disaster, promising robots, open issues – case studies. (12)

UNIT IV: ROBOTS IN SURGERY AND REHABILITATION

Medical robotics, Core concepts, Technology- Medical robotic systems, Research areas and applications- Rehabilitation and Health care robotics: Overview, physical therapy and training Robots- Aids for people with disabilities- Smart prostheses and orthoses, diagnosis and monitoring. (12)

UNIT V: ENTERTAINMENT AND PERSONAL ROBOTICS

Cleaning Robots, lawn moving Robots- Smart appliances and smart homes- The role of Robots in education, Educational robotic platforms-. Robots and informal learning venues (12)
TEXT BOOKS

REFERENCE BOOKS
COURSE OBJECTIVES
- To know the basic knowledge about wireless sensor networks
- To impart knowledge in networking using sensors
- To know about the tools used in networking
- To understand the basic in wireless architecture
- To know about the different techniques used in networking

COURSE OUTCOMES:
- Ability to know about the different techniques used in networking
- To expose basic knowledge about wireless sensor networks
- Ability to know about the tools in networking
- Understand the basic in wireless architecture
- Ability to know about the protocols used in networking

UNIT I: OVERVIEW OF WIRELESS SENSOR NETWORKS

UNIT II: ARCHITECTURE

UNIT III: NETWORKING SENSORS

UNIT IV: INFRASTRUCTURE ESTABLISHMENT
Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. (12)

UNIT V: SENSOR NETWORK PLATFORMS AND TOOLS
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming. (12)

TEXT BOOKS

REFERENCE BOOKS
SEMESTER VII – ELECTIVE III
RA E11 INTERNET TOOLS AND JAVA PROGRAMMING  4  0  0  4

COURSE OBJECTIVES
➢ To learn about the various tools used in internet.
➢ To learn Java Programming.
➢ To understand different Internet Technologies and the way to handle it.
➢ To be familiar with client – side programming and server – side programming.
➢ To learn to develop web based applications.

COURSE OUTCOMES
At the end of the course, the student should be able to:
➢ Implement Java programs and to create a basic website using HTML and Cascading Style Sheets.
➢ Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
➢ Design rich client presentation using AJAX.
➢ Design and implement simple web page in PHP, and to present data in XML format.
➢ Design and implement server side programs using Servlets and JSP.

UNIT I: INTERNET SERVICES AND PROTOCOLS

UNIT II: OBJECT ORIENTATION IN JAVA

UNIT III: PACKAGES AND INTERFACES
Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces. (12)

UNIT IV: EXCEPTION HANDLING
Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses. (12)

UNIT V: MULTI THREADED PROGRAMMING
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
- To recognize and describe the role of unmanned aerial vehicles (UAVs) in past, present, and future society.
- To comprehend and explain various components of UAVs.
- To comprehend and explain basics of flight and flight control systems.
- To understand and describe basics of underwater robots.

COURSE OUTCOMES
At the end of the course, student will be able to
- Understand the challenges in developing autonomous mobile Robots.
- Abstract kinematic control of wheeled mobile Robots.
- Understand the challenges involved in sensory perception for mobile Robots.
- Develop localization and path planning algorithms for mobile Robot navigation.
- Comprehend the challenges and configurations of legged, aerial and underwater Mobile Robots.

UNIT I: OVERVIEW AND BACKGROUND
Definitions- History of UAVs - classifications of UAVs scale- lift generation method- contemporary applications- military- government- civil-societal impact and future outlook- operational considerations- liability / legal issues-insurance- ethical implications- human factors- LOS / BLOS. (12)

UNIT II: PAYLOAD FOR UAV

UNIT III: UNMANNED AERIAL SYSTEM (UAS) COMPONENTS
Platforms- configurations- characteristics-applications- propulsion- Internal combustion - on-board flight control- payloads- sensing / surveillance- weaponized- delivery- communications- command/control- telemetry - launch / recovery systems- Ground control stations. (12)

UNIT IV: UNDERWATER ROBOTICS
Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - Overview about Environmental Factors affecting object in water. (12)

UNIT V: CONTROL SYSTEM AND MANIPULATOR
AUTONOMOUS UNDERWATER SYSTEMS: Introduction to AUVS - Development of
AUVs, ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used.

**TEXT BOOKS:**

**REFERENCE BOOKS:**
COURSE OBJECTIVES
➢ To impart knowledge in the field of computer vision applied to guidance of manipulators and mobile Robots.

COURSE OUTCOMES
At the end of the course, student will be able to
➢ Understand the foundations of the field of computer vision required for Robot vision.
➢ Explain the Mathematics and Implementation of vision guidance for manipulators.
➢ Formulate the various ways to utilize computer vision for mobile Robots.
➢ Develop algorithms for Motion analysis.
➢ Apply the computer vision algorithms for suitable applications involving Manipulators and mobile Robots.

UNIT I: INTRODUCTION

UNIT II: VISUAL SERVOING
Mathematical formulation of visual servo problem-classification of visual servoing architectures-Image based visual servoing (IBVS), Interaction matrix derivation-Geometrical interpretation of IBVS, stability analysis-Case study: IBVS with stereo vision system-IBVS with other geometrical features, direct estimation-Position based visual servoing: Point feature based motion, pose based motion-Calibration for visual servoing systems. (12)

UNIT III: VISION FOR MOBILE ROBOTS
Introduction to simultaneous localization and mapping, visual SLAM (VSLAM)-VSLAM approaches-Introduction to visual odometry (VO).VO: Motion from Image feature correspondences, motion from 3D structure. Comparison between VSLAM and VO calibration techniques-Case study of VSLAM and VO application. (12)

UNIT IV: MOTION ANALYSIS

UNIT V: ADVANCED TOPICS
Hybrid visual servoing, partitioned visual servoing, switching -schemes in visual servoing. Joint space control of eye-in-hand and eye-to-hand systems-Motion based segmentation. Structure from motion (SFM), multi-view SFM-3-D structure and motion from motion field. (12)

TEXT BOOK:
REFERENCE BOOKS:
COURSE OBJECTIVES
- Identify and describe different types of medical robots and their potential applications.
- Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
- Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image-guided interventions.
- Be familiar with the state of the art in applied medical robotics and medical robotics research.
- Understand the various roles that robotics can play in healthcare.

COURSE OUTCOMES
- The students will be able to simulate a MIS procedure and be aware of the state-of-art in surgical and oncology robotics.
- Students should be able to have a fundamental understanding of robot kinematics and dynamics.
- Understand the challenges in the design of a medical robotic system given the specific requirements for a particular application.
- Appreciate the design, development, and evaluation of a medical robotic system.

UNIT I: INTRODUCTION
Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare. (12)

UNIT II: LOCALIZATION AND TRACKING
Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems - Hybrid systems. (12)

UNIT III: SURGICAL ROBOTICS

UNIT IV: REHABILITATION

UNIT V: DESIGN OF MEDICAL ROBOTS
Characterization of gestures to the design of robots- Design methodologies- Technological choices- Security. (12)

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
- The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

COURSE OUTCOMES
After the completion of this course, the students will be able to:
- Understand internet of Things and its hardware and software components
- Interface I/O devices, sensors & communication modules
- Remotely monitor data and control devices
- Develop real life IoT based projects

UNIT I: INTRODUCTION

UNIT II: COMMUNICATION BUS PROTOCOLS

UNIT III: ETHERNET SYSTEMS
IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigbit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet. (12)

UNIT IV: WIRELESS COMMUNICATIONS

UNIT V: APPLICATIONS

TEXT BOOKS:
REFERENCE BOOKS:
SEMESTER VII – ELECTIVE IV

RA E16 OPERATIONS RESEARCH 4 0 0 4

COURSE OBJECTIVES

- To provide knowledge and training in applying optimization techniques under limited resources for the engineering and business problems.

COURSE OUTCOMES

- Upon completion of this course, the students can able to use the optimization techniques for use of engineering and Business problems.
- Students will have the ability to develop Mathematical Model for Engineering problems.

UNIT I: LINEAR MODELS
The phase of an operation research study – Linear programming – Graphical method – Simplex algorithm – Duality formulation – Sensitivity analysis – Case studies. (12)

UNIT II: TRANSPORTATION MODELS AND NETWORK MODELS

UNIT III: INVENTORY MODELS
Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice – Case studies on Inventory (12)

UNIT IV: QUEUEING MODELS
Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation case studies. (12)

UNIT V: DECISION MODELS

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

➢ To understand the application of computers in various aspects of Manufacturing viz., Design, Process planning, Manufacturing cost, Layout & Material Handling system.

COURSE OUTCOMES

➢ Explain the basic concepts of CAD, CAM in Computer Integrated Manufacturing systems.
➢ Summarize the production planning and control and Computerized process planning by differentiating the different coding systems used in group technology.
➢ Explain the concepts of Flexible manufacturing system (FMS) and Automated guided vehicle (AGV) system.
➢ Classification of robots used in Industrial applications.

UNIT I: INTRODUCTION


UNIT II: PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING


UNIT III: CELLULAR MANUFACTURING


UNIT IV: FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)


UNIT V: INDUSTRIAL ROBOTICS

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot

TEXT BOOK:

REFERENCE BOOKS:
COURSE OBJECTIVES
This course introduces students to concepts and methods of modern statistical quality control.
- Students learn to apply standard quality control tools.
- They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations.
- They learn theory and methods for analyzing the performance of different quality control tools used in Industry practices.
- To learn some softwares related to statistics & Quality control.

COURSE OUTCOMES
- Principles of probability and statistics and their appropriate application to quality engineering, including use of computer software.
- Through homeworks and computer projects, students learn to formulate and solve quality characteristic monitoring problems.
- Assignment and class discussion on relationship between product quality, public safety, liability, and professional ethics.
- Use of interactive PC-based computer programs for statistical analysis. MATLAB is introduced in class, students may also use Excel or specialized mathematical and statistical packages.

UNIT I: STATISTICAL PROCESS CONTROL
Chance and assignable causes of quality variation, statistical basis of the control charts - Basic principles, choice of control limits, Analysis of patterns on control charts. (12)

UNIT II: CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES
chart, R chart, chart, p chart, np chart, c chart, and u chart. (12)

UNIT III: ACCEPTANCE SAMPLING
Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans. (12)

UNIT IV: BASIC RELIABILITY MODELS
The failure distribution – Terminologies in Reliability, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model (MTF): Exponential reliability function. Time - dependent Weibull failure model, Time - Dependent normal failure model. (12)

UNIT V: RELIABILITY OF SYSTEMS
Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system -system structure function, minimal cuts, minimal paths, common mode failures, three state devices. (12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
➢ To introduce the process planning concepts to make cost estimation for various products after process planning.

COURSE OUTCOMES
Upon the completion of this course the students will be able to
➢ Select the process, equipment and tools for various industrial products.
➢ Prepare process planning activity chart for several jobs.
➢ Ability to learn the concept of cost estimation for various operations.
➢ Compute the job order cost for different types of shop floor activities.
➢ Calculate the machining time for various machining operations.

UNIT I: PROCESS PLANNING
Introduction- Process & Production Planning, Process Planning & Concurrent Engineering-

UNIT II: MANUAL AND COMPUTER AIDED PROCESS PLANNING

UNIT III: DIRECT AND INDIRECT COST COMPONENTS

UNIT IV: COST CALCULATIONS
Machined components, welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection. Optimum Machining Conditions: Taylor’s equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis. (12)

UNIT V: BREAK EVEN ANALYSIS
Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications - Linear, multi product break-even analysis, Cost Management: Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications. (12)
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To understand the detailed introduction of the Nano scalesystems.
- To understand the concepts of Quantum Dots and Synthesis of Nanostructure Materials.

COURSE OUTCOMES

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

- Have a knowledge of Nano science and nanotechnology including theory & practical application.
- Potentially apply the concepts of Quantum Dots and Synthesis of Nanostructure Materials in research projects.
- Understanding scaling of Electronic components for producing MEMS switches.
- Propose novel ideas using the concepts of characterization and Nanotechnology application.

UNIT I: NANOSCALE SYSTEMS

Length, energy, and time scales - Quantum confinement of electrons in semiconductor nanostructures: Quantum confinement in 3D, 2D, 1D and zero dimensional structures - Size effect and properties of nanostructures- Landauer - Buttiker formalism for conduction in confined geometries - Top down and Bottom up approach. (12)

UNIT II: QUANTUM DOTS

Excitons and excitonic Bohr radius – difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods- MOCVD and MBE growth of quantum dots - current-voltage characteristics - magneto tunneling measurements - spectroscopy of Quantum Dots: Absorption and emission spectra - photo luminescence spectrum - optical spectroscopy - linear and nonlinear optical spectroscopy. (12)

UNIT III: INTRODUCTION TO MEMS AND NEMS

working principles as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation – micro grippers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Pizoresistivity, Pizoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc. (12)

UNIT IV: INTRODUCTION ELECTRONIC SCALING

Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single-Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Coulomb Blockade in a Nanocapacitor, Molecular SETs and Molecular Electronics. (12)

UNIT V: NANOTECHNOLOGY APPLICATIONS

TEXT BOOKS:

REFERENCE BOOKS:
SEMESTER VIII– ELECTIVE V
RA E21 COGNITIVE ROBOTICS 4 0 0 4

COURSE OBJECTIVES
- To understand the fundamentals of Biometric terms.
- To acquire knowledge on Fingerprint Identification, Iris Recognition, Face Recognition and learn about their real time applications.
- To frame ideas on working of Voice Scan and Integrating it with other Biometric systems.

COURSE OUTCOMES
- Apply their knowledge of machine vision and robot kinematics to create computer programs that control mobile robots and robot arms, enabling the robots to recognize and manipulate objects and navigate their environments.
- Explain how a robot can be designed to exhibit cognitive goal-directed behaviour through the integration of computer models of visual attention, reasoning, learning, prospection, and social interaction.
- Create computer programs that realize limited instances of each of these models.

UNIT I: BIOMETRIC FUNDAMENTALS
Key Biometric terms and Processes – Definitions-verification and identification – Matching, Accuracy in Biometric Systems – False match rate - False on match rate - Failure to enroll rate – Derived metrics - An Introduction to Biometric Authentication Systems- a taxonomy of application environment, a system model, biometrics and privacy. (12)

UNIT II: FINGERPRINT IDENTIFICATION TECHNOLOGY

UNIT III: IRIS RECOGNITION
Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses, System Performance, Future Directions. (12)

UNIT IV: FACE RECOGNITION
Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition- Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition. (12)

UNIT V: VOICE SCAN

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To introduce students about the basic concepts and techniques of Machine Learning
- To become familiar with regression methods, classification methods, clustering methods.
- To become familiar with Dimensionality reduction Techniques.

COURSE OUTCOMES

Students will be able to:

- Gain knowledge about basic concepts of Machine Learning Environment.
- Identify machine learning techniques suitable for a given problem.
- Solve the problems using various machine learning techniques.
- Apply Dimensionality reduction techniques.
- Design application using machine learning techniques.

UNIT I: INTRODUCTION


UNIT II: ADVANCED SUPERVISED LEARNING:


UNIT III: CASE STUDY 1

Line following using Supervised Learning techniques. Goal: A simulation model will be developed for understanding both regression and classification techniques. A framework need to be fixed and the complexity of the model will be varied in order to analyze the effect on the system. The effectiveness of the Biasvariance has to be studied.

UNIT IV: UNSUPERVISED LEARNING


UNIT V: NEURAL NETWORKS

Network Representation, Feed-forward Networks, Back propagation, Gradient-descent method. CASE STUDY: Obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network. Goal: A hands-on experience with real world noisy data. The stochastic PCA and the PCA neural network are used to find low dimensional features. The low dimensional features can be used to build a feed-forward neural network in order to ascertain automatic navigational queries like: Where are the free spaces? How can robot reach the goal?
TEXT BOOKS:

3.

REFERENCE BOOKS:

COURSE OBJECTIVES

- The objective of this course is to expose students to the fundamental aspects of the emerging field of microbotics.
- This includes a focus on physical laws that predominate at the microscale, technologies for fabricating small devices, bio-inspired design, and applications of the field.

COURSE OUTCOMES

Students will be able to:
- Formulate the specifications of a mechatronic system.
- Design of mechatronic systems (choice of sensors, actuators, embedded systems)
- Explain and apply the concepts of mass, energy, and momentum balance.
- Model design, and optimize energy conversion systems and Industrial processes.
- Characterize experimentally the steady-state or dynamic response of solids and fluids.
- Apply adapt, and synthesize learned engineering skills to create novel solutions.
- Expound and Iterate multiple design concepts based on the models and simulations.
- Describe in scientific terms and apply the principles of tribology and contact mechanics.

UNIT I: INTRODUCTION

MST (Micro System Technology) – Micromachining - Working principles of Microsystems - Applications of Microsystems-Case studies. (6)

UNIT II: SCALING LAWS AND MATERIALS FOR MEMS

Introduction - Scaling laws - Scaling effect on physical properties, scaling effects on Electrical properties, scaling effect on physical forces. Physics of Adhesion - Silicon-compatible material system - Shape memory alloys - Material properties: Piezoresistivity, Piezoelectricity and Thermoelectricity. (12)

UNIT III: FLEXURES, ACTUATORS AND SENSORS

Elemental flexures - Flexure systems - Mathematical formalism for flexures.Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuators. Electromagnetic sensors, Optical-based displacement sensors, Motion tracking with microscopes. (12)

UNIT IV: MICROROBOTICS

Introduction, Task specific definition of micro-robots - Size and Fabrication Technology based definition of microrobots - Mobility and Functional-based definition of microbot - Applications for MEMS based microbots. (12)

UNIT V: IMPLEMENTATION OF MICROROBOTS

Arrayed actuator principles for microbotic applications – Micro-robotic actuators -Design of locomotive microbot devices based on arrayed actuators. Microbotics devices: Micro-

UNIT VI: MICROFABRICATION AND MICROASSEMBLY
Micro-fabrication principles - Design selection criteria for micromachining - Packaging and Integration aspects – Micro-assembly platforms and manipulators. (6)

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

 To gain the knowledge on basics of Ladder Logic, Basic programming, Safety for Hydraulics and Pneumatics, Robot Safety, Robotic Drives, Hardware, and Components, Robot Installations, Vision Systems, and Robot Troubleshooting.

COURSE OUTCOMES

Students will be able to:

 Gain a greater understanding of Industrial robotics, including types, applications, and programming methods.
 Understand the importance of "Robot Safety" by reviewing and demonstrating the different ways to prevent robot accidents.
 Gain a greater understanding of the physical components of industrial and collaborative robots, and how these components operate and allow the robot to perform work.
 Demonstrate the basic steps for installing and maintaining industrial and/or collaborative robots.
 Learn the use of a systematic approach in solving issues that cause robotic malfunction.

UNIT I: REVIEW OF THE BASICS OF INDUSTRIAL ROBOTICS

Identify and describe the basic components of a robot's body and arms - Description of the axis of movement for the robotic arm - Describe the coordinate systems used to program a robot's movement, and review stationary and mobile industrial robots and appropriate applications for each. (12)

UNIT II: ROBOTIC DRIVES, HARDWARE AND COMPONENTS

Describe and demonstrate items used in robots such as frames and frame material, robot joints, bearings, hydraulics drives, pneumatic drives, servomotors and encoders, transmissions, ballscrews, sensors, wiring and hoses - the methods robotic axis control, and describe sensors for robots. (12)

UNIT III: ROBOT INSTALLATION

Packing/unpacking and transporting the robot, installing the robot and the controller, making connections of power, grounding and other cables, robotic start-up, writing and loading programs, and troubleshooting the robotic assembly. (12)

UNIT IV: VISION SYSTEMS

Vision system for Industrial Robots including the concepts of linear array, matrix arrays, machine vision, pixel display, camera mounting, image intensity, Vidicon vs. Solid State cameras, lighting, lighting devices, laser vision and machine vision applications. (12)

UNIT V: ROBOT TROUBLESHOOTING

Basic troubleshooting process, useful troubleshooting tools, and common robotic malfunction root causes and corrective actions. Collection and organization of troubleshooting information, as well as the use of troubleshooting manuals and flow charts,
assessment of troubleshooting costs, working backwards, the 5 Whys Technique, implementation of corrective actions, temporary vs. permanent corrective actions, and system testing following corrective action. (12)

TEXT BOOKS:

REFERENCES:
2. ANSI/RIA R15.06 2012
COURSE OBJECTIVES

➢ The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product as and how to incorporate them suitably in product.

COURSE OUTCOMES

➢ The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

UNIT I: INTRODUCTION


UNIT II: CONCEPT GENERATION AND SELECTION


UNIT III: PRODUCT ARCHITECTURE


UNIT IV: INDUSTRIAL DESIGN


UNIT V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

Definition – Estimation of Manufacturing cost – Reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution. (12)
TEXT BOOK:


REFERENCE BOOKS:

SEMESTER VIII – ELECTIVE VI
RA E26 LEAN MANUFACTURING

COURSE OBJECTIVES
- To introduce the students the lean manufacturing concepts
- To understand group technology and use of it for part identification
- To understand value stream mapping in lean manufacturing.
- To teach the tools and method used in lean manufacturing
- To introduce concept of Total Productive Maintenance and other system

COURSE OUTCOMES
- Ability to implement lean manufacturing concepts in industries.
- Ability to apply group technology and cellular layout in manufacturing.
- Ability to apply value stream mapping and take time calculations.
- Ability to use the lean manufacturing tools and method.
- Ability to apply total productive maintenance concepts in industries.

UNIT I: INTRODUCTION:

UNIT II: GROUP TECHNOLOGY AND CELLULAR LAYOUT

UNIT III: VALUE STREAM MAPPING :
The value stream – benefits mapping process - the current state map – mapping icons - mapping steps. VSM exercises - Take time calculations. (12)

UNIT IV: LEAN MANUFACTURING TOOLS AND METHODOLOGIES
: Standardized work– standard work sequence timing and working progress .Quality at source – Autonomation /Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S-audit - visual control aids for improvement, flexible work force (12)

UNIT V: TOTAL PRODUCTIVE MAINTENANCE
TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES
➢ To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

COURSE OUTCOMES
➢ Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.
➢ Ability to recall the basics of entrepreneurship
➢ Ability to develop a business model
➢ Ability to identify forms of business organization
➢ Ability to determine the financial need for new Business
➢ Ability to apply industry, competitor and market Analysis

UNIT I: INTRODUCTION TO ENTREPRENEURSHIP

UNIT II: DEVELOPING AN EFFECTIVE BUSINESS MODEL
The Importance of Business Model – Starting a small scale industry - Components of an Effective Business Model. Appraisal of Projects: Importance of Evaluating various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. (12)

UNIT III: FORMS OF BUSINESS ORGANIZATION
Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. (12)

UNIT IV: FINANCING THE NEW VENTURE

UNIT V: THE MARKETING FUNCTION

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

COURSE OUTCOMES

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
- Ability to analyses and solve disaster issue using case study approach

UNIT I: INTRODUCTION TO DISASTERS
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II: APPROACHES TO DISASTER RISK REDUCTION (DRR)
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders - Institutional Processes and Framework at State and Central Level-State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III: INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV: DISASTER RISK MANAGEMENT IN INDIA
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment
UNIT V: DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

(12)

TEXTBOOKS:

REFERENCE BOOKS:
1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
COURSE OBJECTIVES
- To facilitate the understanding of Quality Management principles and process.

COURSE OUTCOMES
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.
- Ability to remember the basics of quality
- Ability to apply TQM tools and techniques to resolve quality problems
- Ability to demonstrate quality management system

UNIT I: INTRODUCTION

UNIT II: TQM PRINCIPLES
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. (12)

UNIT III: TQM TOOLS AND TECHNIQUES - I
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. (12)

UNIT IV: TQM TOOLS AND TECHNIQUES - II
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. (12)

UNIT V: QUALITY MANAGEMENT SYSTEM

TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES
- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

COURSE OUTCOMES
- The student would understand the framework and scope of supply chain networks and functions.
- To recall the role, scope and decision phases of supply chain.
- To identify the factors, option of distribution network design.
- To analyse the roles and factors of transportation decision and network.
- To explore the role of governing and coordination in supply chain.
- To identify the role of IT in supply chain.

UNIT I : INTRODUCTION
Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain -Decision Phases in Supply Chain – Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles. (12)

UNIT II : SUPPLY CHAIN NETWORK DESIGN

UNIT III : LOGISTICS IN SUPPLY CHAIN
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation. (12)

UNIT IV: SOURCING AND COORDINATION IN SUPPLY CHAIN
Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration – sourcing planning and analysis – supply chain co ordination – Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain. (12)

UNIT V : SUPPLY CHAIN AND INFORMATION TECHNOLOGY
The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain. (12)

TEXT BOOK :

REFERENCE BOOK: