DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech

ROBOTICS AND ARTIFICIAL INTELLIGENCE (R&AI)

2023
CURRICULUM & SYLLABUS
2023
B.Tech Programme
ROBOTICS AND ARTIFICIAL INTELLIGENCE (R&AI)

Programme Overview

The Robotics and Artificial Intelligence (R&AI) undergraduate programme amalgamates multiple engineering disciplines such as Mechanical Engineering, Electrical Engineering, and Computer Science and Engineering. R&AI programme introduces the leading technologies underlying the development of Robotic and Intelligent systems, including Machine Learning (ML) and AI, that sense and interact with their physical environment. AI empowers the robots making them more efficient to perceive, learn and make decisions like humans. Industries are going through the fourth industrial revolution (Industry 4.0), which utilizes Robotics and AI to perform the data-intensive and repetitive tasks to achieve human-robot collaboration. Hence, the need for a skilled workforce in industries with knowledge of Robotics & AI is in growing demand.

The students will get trained in Robotics and AI through a well-structured curriculum designed with the participation of industry experts and academicians. Students can study and implement multidisciplinary concepts such as machine vision, machine learning, edge computing, IoT, Cobots, and Industry 4.0. The coursework, such as mathematics for intelligent systems, fundamentals of AI, Deep learning, Big Data Analytics, Reinforcement Learning, etc., equip students to implement several AI projects to hone skills such as critical thinking, problem-solving, and practical implementation of AI in robotic technologies. Students also get an opportunity to avail of exchange programs at other universities where similar research on Robotics & AI is being focused. The interdisciplinary lab experience gained by the students through the projects and group activities imparts the necessary knowledge to fetch either a job or admission to higher studies aspired by the students.

After completing the program, the students will have strong knowledge of designing, developing, and testing algorithms for implementing AI in robotic systems for industrial and societal applications. The graduating students can create highly efficient machines and human-friendly interfaces for intelligently automating robotic systems addressing the modern challenges in automation. In addition to the core engineering courses, the students are exposed to imparting human values and life-long learning skills.
GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM
Cat - Category
L - Lecture
T - Tutorial
P - Practical
C - Credits
RAI - Robotics and Artificial Intelligence
ENG - Engineering Sciences
SCI - Basic Sciences (including Mathematics)
GEC - General Engineering (including programming foundations)
HUM - Humanities (including Languages and others)
PRJ - Project Work (including mini project/internship)
CSE - Computer Science and Engineering
CUL - Cultural Education
ECE - Electronics and Communication Engineering
EEE - Electrical and Electronics Engineering
MAT - Mathematics
MEE - Mechanical Engineering
ELE - Electives (Professional electives, Free electives, Open Electives)
ADC - Audit Courses (P/F)
LIV - Live-in-Labs
ADM - Amrita Darshanam

Program Educational Objectives (PEOs) - Program educational objectives are the broad statements describing the career and professional accomplishments the program prepares graduates to achieve. Student outcomes are statements that describe what students are expected to know or be able to do by the time they complete an academic program.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude, and behavior that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

Program Specific Outcomes (PSOs) – Program Outcomes are statements describing what students are expected to acquire specific knowledge, skills, and attitudes through the program. PSOs are written by the department offering the program.

Course Outcomes (COs) – Statements that describe what students are expected to know and can do at the end of each course. These relate to the skills, knowledge, and behavior students acquire in their progress through the course.
VISION AND MISSION OF THE DEPARTMENT

Vision

To transform our students into outstanding mechanical engineers with strong domain knowledge and skills, society-centric research intent, and exemplary ethical values, making them the most desired professionals by research institutions, industry, and society.

Mission

- To develop in each student a profound understanding of fundamentals, motivation for continuous learning, and practical problem-solving skills for building a successful career.
- To create and share technical knowledge and collaborate with Industry and Institutions for the betterment of society.
- To imbibe ethical values, leadership skills, and entrepreneurial skills in students.
- To sustain a conducive environment to involve students and faculty in research and development.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Apply their Knowledge in Science, Mathematics, and Engineering to address Industrial and Societal problems with a strong emphasis on creativity, confidence, ethics, and responsibility.

PEO2: Apply the latest computational, analytical, and simulation tools and techniques to develop and improve products and processes.

PEO3: Solve multidisciplinary problems by working in cross-functional teams.

PEO4: Develop and upgrade technical, intellectual, and emotional skills for life-long learning to compete in a rapidly evolving world.

PEO5: Nurture entrepreneurial ventures and foster research activities that support sustainable economic development to enhance the quality of life.
PROGRAM OUTCOMES FOR ENGINEERING

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

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

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

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

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

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

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

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

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

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

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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

**PSO 1**: Design and develop cost-effective robotic systems catering to Industrial and Societal requirements.

**PSO 2**: Develop cost-effective, safe, and efficient AI-based automation systems for manufacturing applications, focusing on product development and process improvement.

**PSO 3**: Apply the acquired knowledge and skills in AI to address real-life multidisciplinary engineering problems.
# CREDIT STRUCTURE OF THE PROGRAMME

## Categories of Courses & Credit Breakups

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CATEGORY</th>
<th>Semester wise Credits</th>
<th>% share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S1</td>
<td>S2</td>
</tr>
<tr>
<td>1.</td>
<td>Humanities &amp; Social Science Courses</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Basic Science (including Mathematics) &amp; General Engineering courses</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>3.</td>
<td>Engineering Core Courses</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>Professional Elective Courses, Free Electives &amp; Open Elective Courses, Live-in-Labs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>Project work, Seminar, and Internship in Industry or elsewhere</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.</td>
<td>Audit Courses [Environmental Sciences, Research Methodology, Indian Constitution]</td>
<td>ES</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>S.No.</td>
<td>Description</td>
<td>Page No.</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CURRICULUM</td>
<td>09</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>PROFESSIONAL ELECTIVES - List</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>COURSE EVALUATION SCHEME</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>B.Tech - SYLLABUS</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SEMESTER 1 - Syllabus</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SEMESTER 2 - Syllabus</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>SEMESTER 3 - Syllabus</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SEMESTER 4 - Syllabus</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>SEMESTER 5 - Syllabus</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>SEMESTER 6 - Syllabus</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>SEMESTER 7 - Syllabus</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>SEMESTER 8 - Syllabus</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>PROFESSIONAL ELECTIVES - Syllabus</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>BASKET 1: FIELD / SERVICE ROBOTS - Syllabus</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>BASKET 2: ADVANCED ROBOTICS TECHNOLOGIES - Syllabus</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>BASKET 3: AI / INTELLIGENT SYSTEMS - Syllabus</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>BASKET 4: ADVANCED SENSORS AND COMMUNICATION SYSTEMS - Syllabus</td>
<td>134</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>BASKET 5: ADVANCED MANUFACTURING TECHNOLOGIES - Syllabus</td>
<td>143</td>
<td></td>
</tr>
</tbody>
</table>
# CURRICULUM

## BTECH R&AI

### SEMESTER I

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23MAT126</td>
<td>Mathematics for Intelligent Systems - 1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23PHY108</td>
<td>Engineering Physics</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23CSE116</td>
<td>C Programming</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23EEE105</td>
<td>Basic Electrical and Electronics Engineering</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>GEC</td>
<td>23MEE106</td>
<td>Engineering Graphics and 3D Modelling</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>22AVP103</td>
<td>Mastery Over Mind</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>22ADM101</td>
<td>Foundations of Indian Heritage</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENG101</td>
<td>Technical Communication</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENV300</td>
<td>Environmental Science</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>(P/F)</td>
</tr>
</tbody>
</table>

**TOTAL** 22

### SEMESTER II

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23MAT131</td>
<td>Mathematics for Intelligent Systems – 2</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23CSE117</td>
<td>Object Oriented Programming</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23MEE112</td>
<td>Elements of Mechanical Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23MEE116</td>
<td>Engineering Mechanics</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23MEE182</td>
<td>Manufacturing Practices-B</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>ENG</td>
<td>23ECE118</td>
<td>Sensors and Signal Processing</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI111</td>
<td>Fundamentals of Artificial Intelligence</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>22ADM111</td>
<td>Glimpses of Glorious India</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL** 22
### SEMESTER III

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23MAT221</td>
<td>Mathematics for Intelligent Systems - 3</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>GEC</td>
<td>23CSE207</td>
<td>Python Programming</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>GEC</td>
<td>23MEE207</td>
<td>Design Thinking</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>GEC</td>
<td>23MEE208</td>
<td>Materials Science</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23MEE209</td>
<td>Theory of Mechanisms and Machines</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>ENG</td>
<td>23EEE206</td>
<td>Actuators and Drives</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23ECE207</td>
<td>Micro Controllers and Embedded Systems</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>HUM</td>
<td></td>
<td>Amrita Value Program 1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>ADC</td>
<td>23LAW300</td>
<td>Indian Constitution</td>
<td></td>
<td></td>
<td></td>
<td>(P/F)</td>
</tr>
<tr>
<td>HUM</td>
<td>23LSE201</td>
<td>Life Skills for Engineers I</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>P/F</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td>2</td>
<td>2</td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>

### SEMESTER IV

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23MAT226</td>
<td>Mathematics for Intelligent Systems - 4</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23CSE215</td>
<td>Data Science</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI211</td>
<td>Kinematics of Robotic Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23EEE216</td>
<td>Control Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23MEE216</td>
<td>Manufacturing Processes</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI281</td>
<td>Robot Kinematics and Control System Lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>ELE</td>
<td></td>
<td>Free Elective**</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23LSE211</td>
<td>Life Skills for Engineers II</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td></td>
<td>Amrita Value Program 2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>21</td>
</tr>
</tbody>
</table>

### SEMESTER V

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23MAT307</td>
<td>Graph Theory Algorithms for Robotics</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI301</td>
<td>Fluid Power Systems</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI302</td>
<td>Dynamics and Control of Robotic Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Cat.</td>
<td>Code</td>
<td>Title</td>
<td>L T P</td>
<td>Credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------------------------------------------</td>
<td>-------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI303</td>
<td>Machine Learning</td>
<td>3 0 3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI304</td>
<td>Robot Operating System</td>
<td>1 0 3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI381</td>
<td>Fluid Power Systems and Robot Dynamics &amp; Control Lab</td>
<td>0 0 3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI305</td>
<td>Introduction to Drones</td>
<td>1 0 3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADC</td>
<td>23RAI300</td>
<td>Research Methodology</td>
<td>-</td>
<td>P/F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELE</td>
<td>23LIV390*</td>
<td>Professional Elective 1 / Live-in-Lab I*</td>
<td>3 0 0</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUM</td>
<td>23LSE301</td>
<td>Life Skills for Engineers III</td>
<td>1 0 2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>22</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SEMESTER VI**

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L T P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG</td>
<td>23MEE316</td>
<td>Additive Manufacturing</td>
<td>1 0 3</td>
<td>2</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI311</td>
<td>Mobile Robots</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI312</td>
<td>Deep Learning</td>
<td>2 0 3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI313</td>
<td>IoT and Automation</td>
<td>2 0 3</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI382</td>
<td>Mobile Robots Lab</td>
<td>0 0 3</td>
<td>1</td>
</tr>
<tr>
<td>PRJ</td>
<td>23RAI398</td>
<td>Mini Project</td>
<td>0 0 6</td>
<td>2</td>
</tr>
<tr>
<td>ELE</td>
<td>23LIV490*</td>
<td>Professional Elective 2 / Live-in-Lab II*</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ELE</td>
<td></td>
<td>Professional Elective 3*</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23LSE311</td>
<td>Life Skills for Engineers IV</td>
<td>1 0 2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>22</strong></td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER VII

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGG</td>
<td>23RAI401</td>
<td>Computer Integrated Manufacturing</td>
<td>3 0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ENGG</td>
<td>23RAI402</td>
<td>Reinforcement Learning</td>
<td>2 0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>ENGG</td>
<td>23RAI481</td>
<td>System Simulation Laboratory</td>
<td>0 0</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>ELE</td>
<td></td>
<td>Professional Elective 4*</td>
<td>3 0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ELE</td>
<td></td>
<td>Professional Elective 5*</td>
<td>3 0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PRJ</td>
<td>23RAI497</td>
<td>Summer Internship</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>PRJ</td>
<td>23RAI498</td>
<td>Project Phase I</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

### SEMESTER VIII

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRJ</td>
<td>23RAI499</td>
<td>Project Phase II</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>ELE</td>
<td></td>
<td>Professional Elective 6*</td>
<td>3 0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

**TOTAL CREDIT** 160

*Professional Elective* - Electives categorized under Engineering, Science, Mathematics, Live-in-Labs, and NPTEL Courses. Students can opt for such electives across departments/campuses. Students with a CGPA of 7.0 and above can opt for 2 NPTEL courses with credits not exceeding 8.

**Free Electives** - This will include courses offered by the Faculty of Humanities and Social Sciences, Faculty of Arts, Commerce and Media / Faculty of Management/Amrita Darshanam - (International Centre for Spiritual Studies).

***Live-in-Labs*** - Students undertaking and registering for a Live-in-Labs project can be exempted from registering for an Elective course in the higher semester.

**Note:**
Refer to the intranet page (intranet.cb.amrita.edu) for B.Tech. Programs Common Electives including a) Professional Electives – Sciences b) Free Electives – Management/Humanities/ Social Sciences

https://intranet.cb.amrita.edu/download/DeanEngg/Curriculum_Syllabus/Undergraduate_Programs/B_Tech_01/Engineering_Common_Electives.pdf
## PROFESSIONAL ELECTIVES - LIST

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Code</th>
<th>Title</th>
<th>L T P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>BASKET 1: FIELD / SERVICE ROBOTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI331</td>
<td>Bio-Inspired Robots</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI332</td>
<td>Humanoid Robots</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI333</td>
<td>Medical Robots</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI334</td>
<td>Underwater Robots</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI335</td>
<td>Cognitive Robots</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>ENG</td>
<td>23RAI336</td>
<td>Advanced Drones Technology</td>
<td>2 0 3</td>
<td>3</td>
</tr>
</tbody>
</table>

|      |        | **BASKET 2: ADVANCED ROBOTICS TECHNOLOGIES**    |       |        |
| ENGG | 23RAI341 | Intelligent Control Systems for Robots          | 3 0 0 | 3      |
| ENGG | 23RAI342 | Optimization for Robot Modelling                | 2 0 3 | 3      |
| ENGG | 23RAI343 | Computer Vision and Image Processing            | 3 0 0 | 3      |
| ENGG | 23RAI344 | Advanced Materials for Robotics                 | 3 0 0 | 3      |
| ENGG | 23RAI345 | Advanced Robotics and Analysis                  | 3 0 0 | 3      |
| ENGG | 23RAI346 | Simulation Modeling of Engineering Systems      | 3 0 0 | 3      |

|      |        | **BASKET 3: AI/INTELLIGENT SYSTEMS**            |       |        |
| ENGG | 23RAI351 | Big Data Analytics                              | 3 0 0 | 3      |
| ENGG | 23RAI352 | Big Data and Database Management                | 3 0 0 | 3      |
| ENGG | 23RAI353 | AI in Natural Language Processing               | 3 0 0 | 3      |
| ENGG | 23RAI354 | AI in Speech Processing                        | 3 0 0 | 3      |
| ENGG | 23RAI355 | Machine Learning Based Condition Monitoring     | 3 0 0 | 3      |
| ENGG | 23RAI356 | Digital Twins                                   | 2 0 3 | 3      |
| ENGG | 23RAI357 | Cloud Computing                                 | 3 0 0 | 3      |
| ENGG | 23RAI358 | Mobile Application Development                 | 3 0 0 | 3      |
| ENGG | 23RAI359 | Virtual and Augmented Reality                   | 3 0 0 | 3      |
| ENGG | 23RAI360 | Cyber Security                                  | 2 0 3 | 3      |

<p>|      |        | <strong>BASKET 4: ADVANCED SENSORS AND COMMUNICATION SYSTEMS</strong> |       |        |
| ENGG | 23RAI371 | Smart Sensors                                    | 3 0 0 | 3      |
| ENGG | 23RAI372 | E Nose for Robots                                | 3 0 0 | 3      |
| ENGG | 23RAI373 | Human Computer Interaction                       | 3 0 0 | 3      |</p>
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>22ADM201</td>
<td>Strategic Lessons from Mahabharatha</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22ADM211</td>
<td>Leadership from Ramayana</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP210</td>
<td>Kerala Mural Art and Painting</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP218</td>
<td>Yoga Therapy and Lessons</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP212</td>
<td>Introduction to Traditional Indian Systems of Medicine</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP201</td>
<td>Amma’s Life and Message to the modern world</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP204</td>
<td>Lessons from the Upanishads</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP205</td>
<td>Message of the Bhagavad Gita</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP206</td>
<td>Life and Message of Swami Vivekananda</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP207</td>
<td>Life and Teachings of Spiritual Masters of India</td>
<td>1-0-0</td>
<td>1</td>
</tr>
<tr>
<td>22AVP208</td>
<td>Insights into Indian Arts and Literature</td>
<td>1-0-0</td>
<td>1</td>
</tr>
</tbody>
</table>
### PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

#### CHEMISTRY

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Course Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23CHY240</td>
<td>Computational Chemistry and Molecular Modelling</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23CHY241</td>
<td>Electrochemical Energy Systems and Processes</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23CHY242</td>
<td>Fuels and Combustion</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23CHY243</td>
<td>Green Chemistry and Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23CHY244</td>
<td>Instrumental Methods of Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23CHY245</td>
<td>Batteries and Fuel Cells</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23CHY246</td>
<td>Corrosion Science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### PHYSICS

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Course Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23PHY240</td>
<td>Advanced Classical Dynamics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23PHY241</td>
<td>Electrical Engineering Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23PHY242</td>
<td>Physics of Lasers and Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23PHY243</td>
<td>Concepts of Nanophysics and Nanotechnology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23PHY244</td>
<td>Physics of Semiconductor Devices</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23PHY245</td>
<td>Astrophysics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Mathematics

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Course Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>23MAT240</td>
<td>Statistical Inference</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23MAT241</td>
<td>Introduction to Game Theory</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SCI</td>
<td>23MAT242</td>
<td>Numerical Methods and Optimization</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM

<table>
<thead>
<tr>
<th>Cat.</th>
<th>Course Code</th>
<th>Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUM</td>
<td>23MNG331</td>
<td>Financial Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MNG332</td>
<td>Supply Chain Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MNG333</td>
<td>Marketing Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MNG334</td>
<td>Project Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MNG335</td>
<td>Enterprise Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MNG336</td>
<td>Operations Research</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MEE321</td>
<td>Industrial Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MEE322</td>
<td>Managerial Statistics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MEE323</td>
<td>Total Quality Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23MEE324</td>
<td>Lean Manufacturing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23CSE321</td>
<td>Software Project Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23CSE322</td>
<td>Financial Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23CSE323</td>
<td>Engineering Economic Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HUM</td>
<td>23CSE324</td>
<td>Information Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS
<table>
<thead>
<tr>
<th>Cat.</th>
<th>Course Code</th>
<th>Title</th>
<th>L T P</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUM</td>
<td>23CUL230</td>
<td>Achieving Excellence in Life - An Indian Perspective</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23CUL231</td>
<td>Excellence in Daily Life</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23CUL232</td>
<td>Exploring Science and Technology in Ancient India</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23CUL233</td>
<td>Yoga Psychology</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENG230</td>
<td>Business Communication</td>
<td>1 0 3</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENG231</td>
<td>Indian Thought through English</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENG232</td>
<td>Insights into Life through English Literature</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENG233</td>
<td>Technical Communication</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23ENG234</td>
<td>Indian Short Stories in English</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23FR230</td>
<td>Proficiency in French Language (Lower)</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23FR231</td>
<td>Proficiency in French Language (Higher)</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23GER230</td>
<td>German for Beginners I</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23GER231</td>
<td>German for Beginners II</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23GER232</td>
<td>Proficiency in German Language (Lower)</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23GER233</td>
<td>Proficiency in German Language (Higher)</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HIN230</td>
<td>Hindi I</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HIN231</td>
<td>Hindi II</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM230</td>
<td>Emotional Intelligence</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM231</td>
<td>Glimpses into the Indian Mind - the Growth of Modern India</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM232</td>
<td>Glimpses of Eternal India</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM233</td>
<td>Glimpses of Indian Economy and Polity</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM234</td>
<td>Health and Lifestyle</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM235</td>
<td>Indian Classics for the Twenty-first Century</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM236</td>
<td>Introduction to India Studies</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM237</td>
<td>Introduction to Sanskrit Language and Literature</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM238</td>
<td>National Service Scheme</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM239</td>
<td>Psychology for Effective Living</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM240</td>
<td>Psychology for Engineers</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM241</td>
<td>Science and Society - An Indian Perspective</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM242</td>
<td>The Message of Bhagwat Gita</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM243</td>
<td>The Message of the Upanishads</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM244</td>
<td>Understanding Science of Food and Nutrition</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23HUM245</td>
<td>Service Learning</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23JAP230</td>
<td>Proficiency in Japanese Language (Lower)</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23JAP231</td>
<td>Proficiency in Japanese Language (Higher)</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23KAN230</td>
<td>Kannada I</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23KAN231</td>
<td>Kannada II</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23MAL230</td>
<td>Malayalam I</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23MAL231</td>
<td>Malayalam II</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23SAN230</td>
<td>Sanskrit I</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23SAN231</td>
<td>Sanskrit II</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23SWK230</td>
<td>Corporate Social Responsibility</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23SWK231</td>
<td>Workplace Mental Health</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23TAM230</td>
<td>Tamil I</td>
<td>2 0 0</td>
<td>2</td>
</tr>
<tr>
<td>HUM</td>
<td>23TAM231</td>
<td>TAMIL II</td>
<td>2 0 0</td>
<td>2</td>
</tr>
</tbody>
</table>
## Course Evaluation Pattern

### Notes

- **L**: Lecture
- **P**: Practical
- **Ext**: External
- **MT**: Mid-Term
- **Exp.**: Experimental work
- **X**: No. of Lecture hours per week
- **Y**: No. of Tutorial hours per week (1)
- **Z**: No. of practical hours per week
- **Q**: Quiz
- **A**: Assignment

*Project component (in-lieu of end semester examination) only for the selected courses as decided by the department level committee*

### Theory, Lab integrated and Pass/Fail (P/F) Courses

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Int : Ext</th>
<th>Evaluation Scheme</th>
<th>Total (100)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L T P</strong></td>
<td><strong>60 : 40</strong></td>
<td>CA1 CA2 MT CA3 CA4 ES</td>
<td>Internal (60)</td>
</tr>
<tr>
<td>X 0 0</td>
<td>Q1/A1 Q2/A2 Exam Q3/A3 Q4/A4</td>
<td>Exam/Project*</td>
<td>CA1+CA2+CA3+CA4 ES</td>
</tr>
<tr>
<td>X Y 0</td>
<td>7.5 7.5 30 7.5 7.5 40</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>X 0 Z P/F</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Lab Based Courses

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 Z</td>
<td>60 : 40</td>
<td>6 weeks Task or Exp. (CA1)</td>
<td>6 weeks Task or Exp. (CA2)</td>
</tr>
<tr>
<td></td>
<td>No. of Task based on the course</td>
<td>MT</td>
<td>No. of Task based on the course</td>
</tr>
<tr>
<td>1 0 Z</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

### Project / Internship

<table>
<thead>
<tr>
<th>PRJ</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CA (60)</td>
<td>ES (40)</td>
<td>Total (100)</td>
</tr>
<tr>
<td><strong>Mini Project / Project Phase 1 &amp; Phase 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Based on Review by panel of experts</td>
<td>External review</td>
<td>CA+ES</td>
</tr>
<tr>
<td><strong>Internship</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>External report (Industry / Research Organization)</td>
<td>Presentation &amp; Internship Report</td>
<td>CA+ES</td>
</tr>
</tbody>
</table>

---

Course Evaluation Pattern

Notes

- **L**: Lecture
- **P**: Practical
- **Ext**: External
- **MT**: Mid-Term
- **Exp.**: Experimental work
- **X**: No. of Lecture hours per week
- **Y**: No. of Tutorial hours per week (1)
- **Z**: No. of practical hours per week
- **Q**: Quiz
- **A**: Assignment

*Project component (in-lieu of end semester examination) only for the selected courses as decided by the department level committee*
Course Objectives

- To lay down the basic concepts and techniques of linear algebra, calculus and probability theory needed for subsequent study.
- To introduce the concepts of computational experiments and understand the theory behind them.
- To provide an appreciation of the wide application of these disciplines within the scientific field.
- To provide the connection between linear algebra, differential equation and probability theory concepts.

Course Outcomes

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

CO1: Apply the introductory concepts and techniques of linear algebra, calculus, complex functions and probability theory.

CO2: Summarise mathematical concepts commonly used in data science and AI.

CO3: Apply the combinations of learned mathematical concepts in the form of computational and algebraic methods.

CO4: Computationally model electrical and mechanical systems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

**Basics of Linear Algebra** - Linear Dependence and independence of vectors - Gaussian Elimination - Rank of set of vectors forming a matrix - Vector space and Basis set for a Vector space - Dot product and Orthogonality - Rotation matrices - Eigenvalues and Eigenvectors and its interpretation - Projection matrix and Regression - Singular Value Decomposition Fields.


Convolution sum, Convolution Integral, Ordinary Linear differential equations, formulation, analytical and Numerical solutions, Impulse Response Computations, formulating state space models of Physical systems.

Examples of ODE modelling in falling objects, satellite and planetary motion, Electrical and mechanical systems. Multivariate calculus, Taylor series, Introduction to Optimization.

Introduction to Probability Distributions and Monte Carlo Simulations.

Lab Practice: Computational Exercises related to topic discussed in course

Text Books / References:

Course Objective:
To expose the essentials of Newtonian mechanics, Wave optics and basic electro-magnetism & electro-dynamics to the Engineering students to enable them to apply in their engineering applications relating to Robotics & AI

Course Outcomes
At the end of the course, the student will be able to:
CO1: Apply the principles of Newtonian Mechanics to solve engineering problems.
CO2: Understand the fundamentals of wave optics and its applications in engineering.
CO3: Understand the essentials of electro-magnetism & electro-dynamics apply them to simple applications.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus
Unit 1

Unit 2
Fundamentals of Wave optics: Theory of superposition - Qualitative: Superposition of two and many Wave trains of the Same Frequency and random phase, Vector addition of amplitudes, Fresnel and Fraunhofer Diffraction - Diffraction by a single and double Slit, intensity variation in single and double slit interference, Effect of increasing the number of Slits(Grating), Intensity distribution from an Ideal grating. Resolving power of grating and grating spectra. Principles of interferometry - Theory of Michelson’s Interferometer and its applications. [15 Hours]

Unit 3

Textbooks

References
D.J. Griffiths, Introduction to Electrodynamics, 3rd edition, Prentice-Hall of India 2005
Course Objectives

- To provide the foundations of computational problem solving and the foundations of programming.
- To familiarize programming languages using C as a tool for implementation.
- To write programs that provide solutions to practical engineering problems.

Course Outcomes

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

CO1: Apply algorithmic thinking to understand, define and solve problems.

CO2: Interpret the typical programming constructs such as data (primitive and compound), control, modularity, and recursion in a program.

CO3: Analyze a given program by tracing, identifying coding errors, and debugging them.

CO4: Develop computer programs that implement suitable algorithms for problem scenarios and applications

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Problem Solving and Algorithmic Thinking: Overview – problem definition, logical reasoning; Algorithmic thinking – Sequence, Selection and Repetition, Problem solving with algorithms – Searching and Sorting, modularization.

Lab Practice: Exercise on Algorithmic thinking and algorithms.

Unit 2


Lab Practice: Exercise on data types, control structures, functions and arrays.

Unit 3

Pointers: Introduction, compatibility, arrays and pointers, Dynamic memory allocation, arrays of pointers, pointer arithmetic. Structures: Structure vs array comparison, complex structures, structures and functions, Union.

Lab Practice: Problem solving using C with Arrays, pointers, structures, and Union.

Text Books


Reference Books


To understand the basic gates and their applications
To impart basics on microprocessor/microcontroller with basics programming skills.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Familiarize the basic concepts in electrical circuits
CO2: Comprehend the study on construction and working of various electrical machines
CO3: Illustrate the working of basic electronic circuits.
CO4: Develop various logic circuits for real world applications.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit I

Unit II

Unit III
Basic Electronic Circuits: Review of PN junction diodes, Voltage regulator, BJT- Transistor as a switch, 555 Timers, Operational Amplifiers – Inverting and Non-inverting amplifier – Instrumentation amplifiers

Unit IV
Introduction to microprocessor and microcontrollers. Case study on applications of microprocessors and microcontrollers.

Lab Practice
1. a) Wiring practices b) Study of Electrical protection systems.
2. Speed control of DC shunt motor
3. Load test on single phase transformer
4. Load test on three phase induction motor
5. Transistor as a switch
6. Implementation of inverting and non-inverting amplifier using Op-amp
7. Full adder and subtractor
8. Program on addition and subtraction
9. Program to storing and retrieving a data

Text Books

Reference Books
Course Objectives
- To understand the BIS and its importance in Technical Drawings.
- To acquire proficiency in orthographic and isometric projection techniques for 2D representation of 3D objects.
- To appreciate the significance of 3D modeling in engineering design and drafting.
- To familiarize with 3D modeling software.
- Develop lateral surface development principles for creating 2D representations of 3D objects.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Demonstrate proficiency in using BIS for drafting.
CO2: Construct engineering drawings using principles of orthographic and isometric projection.
CO3: Develop models using principles of lateral surface development.
CO4: Create proficiency in developing 3D solid models using the software.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
**Introduction to Engineering Graphics and 3D Modeling.** Introduction to BIS of Engineering Drawing – Line type, dimensioning, Significance of 3D modeling. Introduction to 3D Modeling Software.

Unit 2
**Orthographic and Isometric Projections in 3D.** Understanding orthographic projections of points, lines, planes, and solids in 3D. Developing 2D projections of 3D models. Developing sectional views of 3D models of solids. Developing isometric projections from 3D models of solids, Real-world applications of orthographic projections.

Unit 3
**Development of Lateral Surfaces.** Developing lateral surfaces of right regular prisms, cylinders, pyramids, and cones. Understanding the development of surfaces in 3D models, Real-world applications of surface development.

Unit 4

Text Books
- Autodesk Fusion 360: A Power Guide for Beginners and Intermediate Users by John Willis, Sandeep Dogra, and Cadartifex, 4e, CADArtifex

Work Book
- Engineering Graphics Workbook - Created by Department of Mechanical Engineering Faculty Members at Amrita School of Engineering, Coimbatore Campus.

Reference Books
- Autodesk Fusion 360 For Beginners: Part Modeling, Assemblies, and Drawings – Tutorial Book
Course Objectives

- To Mastery Over Mind (MAOM) is an Amrita initiative to implement schemes and organize university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3)
- It introduces immediate and long-term benefits of MAOM meditation and equips every attendee to manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.
- This course will enhance the understanding of experiential learning based on the University’s mission: “Education for Life along with Education for Living” and is aimed to allow learners to realize and rediscover the infinite potential of one’s true Being and the fulfilment of life’s goals.

Course Outcomes

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

CO1: To be able to describe what meditation is and to understand its health benefits
CO2: To understand the causes of stress and how meditation improves well-being
CO3: To understand the science of meditation.
CO4: To learn and practice MAOM meditation in daily life.
CO5: To understand the application of meditation to improve communication and relationships.
CO6: To be able to understand the power of meditation in compassion-driven action.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus:

Unit 1
Describe Meditation and Understand its Benefits (CO1)
A: Importance of meditation. How does meditation help to overcome obstacles in life (Pre-recorded video with Swami Shubhamritananda Puri)
Reading 1: Why Meditate? (Swami Shubhamritananda ji)

Unit 2
Causes of Stress and How Meditation Improves Well-being (CO2)
A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (Pre-recorded video with Dr. Ram Manohar)

Unit 3
The Science of Meditation (CO3)
A: A preliminary understanding of the Science of meditation. What can modern science tell us about this tradition-based method? (Pre-recorded video with Dr. Shyam Diwakar)
B: How meditation helps humanity according to what we know from scientific research (Pre-recorded video with Dr. Shyam Diwakar)
Reading 1: Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar)
Unit 4
Practicing MA OM Meditation in Daily Life (CO4)
Guided Meditation Sessions following scripts provided (Level One to Level Five)
Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami Atmananda Puri)

Unit 5
Improving Communication and Relationships (CO5)
How meditation and mindfulness influence interpersonal communication. The role of meditation in improving relationship quality in the family, at the university and in the workplace. (Pre-recorded video with Dr. Shobhana Madhavan)

Unit 6
Meditation and Compassion-driven Action (CO6)
Understand how meditation can help to motivate compassion-driven action. (Pre-recorded video with Dr. Shobhana Madhavan)

Text Books/Reference Books:
1. Meditation and Spiritual Life-Swami Yatiswarananda, Ramakrishna Math
3. Dhyana Yoga-Holy Gita Swami Chinmayananda
4. Voice of God, Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
5. Hindu Dharma-Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
6. Mind: It’s Mysteries and control-Swami Sivananda Saraswati
8. Books on Amma’s teachings like Awaken children, From Amma’s Heart etc.
Course Objectives

- To introduce students to the depths and richness of the Indian culture and knowledge traditions.
- To enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- To equip students with a knowledge of their country and its eternal values.

Course Outcomes

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

**CO1**: Increase student understanding of true essence of India’s cultural and spiritual heritage. Emancipating Indian histories and practices from manipulation, misunderstandings, and other ideological baggage thus, shows its contemporary relevance.

**CO2**: Understand the ethical and political strategic concepts to induce critical approach to various theories about India.

**CO3**: Familiarize students with the multi-dimension of man’s interaction with nature, fellow beings and society in general.

**CO4**: Appreciate the socio-political and strategic innovations based on Indian knowledge systems. Gives an understanding of bringing Indian teaching into practical life

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

**Unit 1**
Educational Heritage of Ancient India
Life and Happiness
Impact of Colonialism and Decolonization
A timeline of Early Indian Subcontinent

**Unit 2**
Pinnacle of Selflessness and ultimate freedom
Indian approach towards life
Circle of Life
Ocean of love; Indian Mahatmas.

**Unit 3**
Man’s association with Nature
Celebrating life 24/7.
Metaphors and Tropes
Become A Strategic Thinker (Games / Indic activity)
India: In the Views of Other Scholars and Travellers

**Unit 4**
Persona2lity Development Through Yoga.
Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness
Conversations on Compassion with Amma

**Text Book**

*Foundations of Indian Heritage* - In house publication

**Reference Book(s)**

The beautiful tree by Dharampal
Peasants and Monks in British India by William Pinch
India, that is Bharat: Coloniality, Civilisation, Constitution by J Sai Deepak
Awaken Children Dialogues with Mata Amritanandamayi
Man, and Nature by Mata Amritanandamayi Devi
What Becomes of the Soul After Death, Divine Life Society
Course Objectives
- To introduce the students to the fundamentals of mechanics of writing.
- To facilitate them with the style of documentation and specific formal written communication.
- To initiate in them the art of critical thinking and analysis.
- To help them develop scanning techniques for specific information, comprehension and organization of ideas.
- To enhance their technical presentation skills.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Gain knowledge about the mechanics of writing and the elements of formal correspondence.
CO2: Understand and summarize technical documents.
CO3: Apply the essential elements of language in formal correspondence.
CO4: Interpret and analyze information and organize ideas logically and coherently.
CO5: Compose project reports/documents, revise them for language accuracy and make technical presentations.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Unit 1
Mechanics of Writing: Grammar rules - articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agrement, pronoun-antecedent agreement, discourse markers and sentence linkers
General Reading and Listening comprehension - rearrangement & organization of sentences

Unit 2
Different kinds of written documents: Definitions- descriptions- instructions-recommendations- user manuals - reports- proposals
Formal Correspondence: Writing formal Letters Mechanics of Writing: impersonal passive & punctuation
Scientific Reading & Listening Comprehension

Unit 3
Technical paper writing: documentation style - document editing – proof reading - Organizing and formatting
Mechanics of Writing: Modifiers, phrasal verbs, tone and style, graphical representation
Language Lab: Reading and listening comprehension of technical documents
Mini Technical project (10 -12 pages)
Technical presentations

Text Books / Reference Books

Course Objectives
- To familiarize the nature and facts about environment.
- To appreciate the importance of environment by assessing its impact on the human world.
- To introduce the integrated themes and biodiversity, pollution control and waste management.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the various aspects of nature and environment.
CO2: Analyse impact of environment on human world.
CO3: Comprehend pollution control and waste management.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Syllabus**

**Unit 1**
Over view of the global environment crisis – Biogeochemical cycles – Climate change and related international conventions and treaties and regulations – Ozone hole and related International conventions and treaties and regulations

**Unit 2**

**Unit 3**

**Text / Reference Books**

Pre-requisite: Mathematics for Intelligent Systems 1 (Knowledge level)

Course Objective
- To lay down the basic concepts and techniques of linear algebras applied to signal processing.
- To introduce the concepts of computational experiments and understand the theory behind them.
- To provide an appreciation of the wide application of these disciplines within the scientific field.
- To provide a connection between the concepts of linear algebra, differential equation and probability theory.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Develop an understanding of linear algebra's basic concepts and techniques applied to signal processing.
CO2: Identify and describe the connection between the concepts of linear algebra, differential equation and probability theory.
CO3: Develop an insight into the applicability of linear algebra in business and scientific domains.
CO4: Apply the concepts of calculus and linear algebra in modelling electrical and mechanical elements.
CO5: Apply the concepts of probability theory in providing data sets for computational experiments in data science.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO8</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Fourier Series and Fourier Transform and its properties
Formulation of ordinary differential equation with constant coefficients in various engineering domains, Converting higher order into first order equations Numerical solution with Rungekutta method.

Taylor series expansion of multivariate functions, conditions for maxima, minima and saddle points, Concept of gradient and hessian matrices Multivariate regression and regularized regression, Newton methods for optimization, Signal processing with regularized regression.


Random variables and distributions, Expectation, variance, moments cumulants, Sampling from univariate distribution- various methods, Concept of Jacobian and its use in finding pdf of functions of Random variables (RVs), box-muller formula for sampling normal distribution, Concept of correlation and Covariance of two linearly related RVs, Multivariate Gaussian distribution, Bayes theorem, Introduction to Bayesian estimation process, Markov chain, Markov decision process.

Lab Practice: Computational Exercises related to topic discussed in the course
Textbooks / References

Course Objectives
- To enrich the concept of object-oriented software using C++.
- To train the students to create objects and interact among objects using C++.
- To enable the student to use ADT and STL for implementing data structures.
- To inculcate the problems in an object-oriented way using appropriate tools like JIVE.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Summarize the object-oriented concepts.
CO2: Design object-oriented systems using UML.
CO3: Apply the concepts of class and objects in a program.
CO4: Apply the usage of early and late binding, exception handling, and generic programming.
CO5: Develop computer programs that implement suitable algorithms for problem scenarios and applications performance.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Constructors and destructors, instantiation of objects, Types of Constructors, Static Class Data, Array of Objects, Constant member functions and Objects, Memory management Operators. Inheritance, Types of Inheritance, access modes – public, private & protected. Abstract Classes, Ambiguity resolution using scope resolution operator and Virtual base class, Overriding inheritance methods

Unit 3
Constructors in derived classes, Nesting of Classes. Polymorphism Polymorphism, Type of Polymorphism – Compile time and runtime, Function Overloading, Operator Overloading (Unary and Binary) Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, pure virtual functions. Strings, Files and Exception Handling Manipulating strings. Overview of Standard Template Library, Containers, Algorithms, Iterators, Vectors.

Lab Practice: Problem solving using C++

Text Books / Reference Books
CO1: Apply the laws of thermodynamics in applications of thermal systems.
CO2: Determine the performance of internal combustion engines and refrigeration and air conditioning systems.
CO3: Describe and comprehend the various elements of power transmission systems.
CO4: Compute stresses, strains, and deformation of various mechanical components.
CO5: Compute bending stress, shear stress in beams and analyze stresses and deformation in circular shafts due to torsion.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Syllabus**

**Unit 1**

**Basic Concepts of Thermodynamics:** Introduction, states, concept of work, heat, temperature; Zeroth, 1st, 2nd and 3rd laws of thermodynamics; concept of internal energy, enthalpy and entropy – Simple Numerical problems.

**Energy Sources and Power Plants:** Review of energy sources; Working of hydel power plant, thermal power plant, nuclear power plant, solar power plant, tidal power plant, wind power plant.

**Internal Combustion Engines:** Classification, IC engine parts, working of two-stroke & four-stroke petrol engines and four-stroke diesel engines. Application of IC engines.

**Unit 2**

**Simple Machines:** Definition of a machine, velocity ratio, mechanical advantage, efficiency, laws of machines, reversibility of machine, simple & differential wheel and axle, pulleys, screw jacks, numerical problems.

**Power Transmission Systems:** Introduction to power transmission systems. Flat belt, V-belt, chain & rope drives and their applications, gears and gear trains and their application, simple numerical problems.

**Unit 3**

**Simple Stress and Strain:** Introduction, properties of materials, Stress, Strain, Hook’s law, Poisson’s Ratio, Stress-Strain Diagram for structural steel and nonferrous materials, Principles of superposition, Thermal stresses. Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants.

**Bending of Beams:** Bending equation, calculation of stresses in a beam due to bending.

**Torsion of Shafts:** Pure torsion - torsion equation of circular shafts, strength and stiffness, power transmitted by shaft of solid and hollow circular sections.

**Textbooks**

*John Bird and Carl Ross, “Mechanical Engineering Principles”, Newnes, 2002*


**Reference Books**


*V.B. Bhandari, ‘Design of Machine Elements”, 4e, TMH, 2016.*


Course Objectives
- To inculcate the concepts of basic mechanics and problem-solving capabilities using vector approach.
- To familiarize with the concept of the properties of areas and bodies (centroid, first moment, second moment of area).
- To impart comprehensive knowledge on kinematics and kinetics of particles and rigid bodies.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Apply the static equilibrium conditions on a particle and a rigid body in plane and space.
CO2: Evaluate the support-reactions and the internal forces in structures/trusses.
CO3: Compute the properties of areas and bodies of composite sections.
CO4: Apply the concepts of frictional forces at contact surfaces of various engineering systems.
CO5: Compute the kinematic variables of particles and rigid bodies.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Statics of particles in two and three dimensions: Fundamental concepts and principles - forces in a plane - resultant of forces, resolution of a forces, equilibrium of a particle, Free body diagrams, forces in space, equilibrium of a particle in space.

Statics of rigid bodies in two and three dimensions: Moment of force about a point – moment of force about an axis – moment of a couple – equivalent force couple system – rigid body equilibrium – support reactions.

Unit 2
Analysis of trusses: Method of joints and method of sections.


Friction: Basics of friction, ladder friction, wedge friction, rolling resistance.

Unit 3

Dynamics of rigid bodies: General plane motion – translation and rotation of rigid bodies – Chasle’s theorem – velocity and acceleration calculation in moving frames – Corioit’s acceleration.

Text Books

Reference Books
Course Objectives:
- Imparting the knowledge of general safety procedures that should be observed on the shop floor.
- Use modelling software to design and print simple geometry for additive manufacturing processes.
- Hands-on experience in edge preparation, plate, wire and sheet joining operations.
- Explain the different tools and equipment used for basic manufacturing processes.
- Get familiar with the essential components for automation and pneumatic circuit design.
- Discuss the components and functioning of various sub-systems of automobiles, such as the power train, steering system, suspension system, and braking system.

Course Outcomes
At the end of the course, the student will be able to
CO1: Practice safety procedures in a shop floor environment.
CO2: Select appropriate tools and methods for basic manufacturing processes.
CO3: Realize the functionality of parts in an assembly through dismantling and assembling.
CO4: Perform basic metals joining using welding and soldering.
CO5: Fabricate sheet metal components using lateral surface development principles.
CO6: Understand the functioning of automotive systems and realize the importance of recent developments in automotive technologies.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Workshop Safety Measures and Practices - Proper training and supervision before operating unfamiliar or complex equipment.

Product Workshop – 12 hours
Disassemble the product or sub-assembly - Measure various dimensions using measuring instruments - Free hand sketching of the assembly and components - Prepare the bill of materials - Study the functioning of the assembly and parts - Assemble the product or subassembly.

Sheet Metal Fabrication – 12 hours
Study of tools and equipment - Sheet Metal cutting and bending techniques – Sheet metal design principles and practices - Joining & finishing of sheet metal parts. Introduction to Mechanical/Hydraulic press.

Metals Joining practice – 12 hours
Manual arc welding practice for making Butt and Lap joints - Soldering Practice

Automobile Engineering lab – 9 hours
Overview of automobiles – components – functioning of various sub-systems; Power train, steering system, suspension system and braking system. Introduction to electric vehicles, hybrid vehicles, alternate fuels. Introduction to E Mobility.

Reference Books: Lab Manual
Pre-requisite: Elements of Electrical and Electronics Engineering (Knowledge Level)

Course Objectives
- To learn about the basics and performance of measurement systems
- To learn in detail about different sensors
- To learn about signal conditioning circuits
- To learn about various digital signal processing techniques

Course Outcomes
At the end of the course, the student will be able to
CO1: Identify the functional elements, concepts and performance of various measurement systems
CO2: Evaluate the performance characteristics of different types of sensors and transducers for robotic applications.
CO3: Perform preprocessing of signals for improving the quality of the sensor signature.
CO4: Analyze the sensor signatures in time domain and extract frequency components.
CO5: Select suitable sensor and associated signal-processing methods for applications in robotics and automation.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Measurements and measuring systems: Methods of Measurement-Instruments- Classification of Instruments-Functions of instruments and measurement Systems-Elements of a generalized measurement system. Measurement system performance: Static characteristics- Dynamic characteristics. Errors in measurement and their statistical analysis.

Unit 2

Unit 3

Lab Experiments: Sensor and associated signal conditioning circuits for applications in robotics and automation will be studied through the following experiments on sensors as listed below:

1. Calibration curve and time constants (for sensors: mercury in glass thermometer, bimetal dial thermometer, RTD, thermistor and thermocouple)
2. Seebeck effect for thermocouple
3. Temperature transmitter and its calibration
4. Study and calibration of displacement sensors: LVDT and potentiometer
5. Study of Strain Gauge
6. Study of accelerometer and gyroscope
7. Vision based sensing
8. Ultrasonic, IR and Hall effect sensor-based proximity and range sensing
9. Analog to digital and digital to analog conversion.
10. Experimentation with Active Filters
11. Experimentation with DC bridge
12. Experimentation with AC bridge
13. Implementation of convolution and digital filters (Can be done with Raspberry Pi on any analog signal acquired using ADC)
14. Fourier Transforms (Can be done with Raspberry Pi on any analog signal acquired using ADC)

**Text / Reference Books**
Course Objectives:
- To introduce classical AI and rational intelligent agents.
- To introduce techniques for problem solving by search and adversarial games.
- To introduce constraints, logic, and inference techniques.
- To introduce planning, acting, and multi-agent systems.
- To introduce knowledge-representation and reasoning.

Course Outcomes
After completing this course, students will be able to
CO1: Analyse different elements of an AI system.
CO2: Apply elementary principles of AI for problem solving and search
CO3: Apply constraints and logic for intelligent systems
CO4: Apply knowledge representation and reasoning for defining intelligent systems

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO8</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO11</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO12</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Problem Solving by Search: Uninformed and Informed Search Strategies, Heuristic Functions; Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta Pruning

Unit 3
Constraint Satisfaction Problems, Inference in CSPs, Backtracking Search; Knowledge-Based Agents, Propositional and First-Order Logic, Resolution Theorem Proving, Unification Forward and Backward Chaining

Unit 4

Textbooks/References:

Course Objectives
- The course aims at introducing Bhārath in nutshell to the student, which includes the sources of Indian thoughts, eminent personalities who shaped various disciplines, India’s significant contribution to the mankind, the current stature of Indian in the geopolitics and Indian approach to science and ecology.
Course Outcomes

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

CO1: Will be able to recognise the call of Upanishads and outstanding personalities for confronting the wicked in the real world while admiring the valour, pursuit and divinity in both classical and historical female characters of India.

CO2: Will get introduced to Acharya Chanakya, his works, and his views on polity and nation to find synchrony between public and personal life, alongside understanding India's cultural nuances and uniqueness concerning the comprehension of God across major global communities.

CO3: Will be able to appreciate Bhagavad Gita as the source of the Indian worldview through the various Yogic lessons enshrined in it, making it one of India's numerous soft powers, and also understand the faith-oriented mechanism of preserving nature.

CO4: Will be informed about the enormous contribution of Indian civilisation over two and a half millennia to humanity and develop awareness about India's approach toward science, devoid of dogmas and rooted in humanism.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Face the Brutes
Role of Women in India
Acharya Chanakya
God and Iswara

Unit 2
Bhagavad Gita: From Soldier to Samsarin to Sadhaka
Lessons of Yoga from Bhagavad Gita
Indian Soft powers
Preserving Nature through Faith

Unit 3
Ancient Indian Cultures (Class Activity)
Practical Vedanta
To the World from India (For Continuous Assessment)
Indian Approach to Science

Text Book / Reference Book(s)
Textbook Name: Glimpses of Glorious India- In-house publication
Reference Course material

SEMESTER 3

23MAT221 MATHEMATICS FOR INTELLIGENT SYSTEMS - 3 L-T-P-C: 2-0-3-3

Pre-requisite: Mathematics for Intelligent Systems 2 (Knowledge level)

Course Objectives
- To lay down the basic concepts and techniques of linear algebra, calculus and basic-probability theory needed for subsequent study.
- To introduce the concepts of computational experiments and understand the theory behind them.
- To provide an appreciation of the wide application of these disciplines within the scientific field.
- To provide the connection between the concepts of linear algebra, differential equation and probability theory.

Course Outcomes
At the end of the course, the student will be able to:
**CO1**: Illustrate the basic concepts and techniques of linear algebra, calculus and basic probability theory needed for AI & AI-enabled robots.

**CO2**: Integrate the application of these disciplines within the scientific field.

**CO3**: Develop an insight into the applicability of linear algebra in business and scientific domains.

**CO4**: Apply the concepts of calculus and linear algebra in modelling electrical and mechanical elements.

**CO5**: Apply the concepts of probability theory for building datasets for computational experiments in data science.

### CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### Syllabus

#### Linear Algebra -3 - Highlights of Linear Algebra:
- Four Fundamental Spaces, Eigenvalues and Eigenvectors, SVD, PCA and best low-rank matrix.

#### Calculus -3 - Theory of Optimization:

Introduction to PDEs arising in Physics and Engineering (problem formulations and simple numerical methods for solutions).

#### Probability and Statistics-3 -
- Moments, cumulants, and inequalities of statistics, Covariance matrices and joint probabilities, Multivariate Gaussian and weighted least squares, Markov chains, Markov decision process - advanced aspects.

Lab Practice: Computational Exercises based on the topic discussed in the course.

### Text Books / Reference Books

Course Objectives

- Introduce the python language, its modules system, its recommended programming styles and idioms
- Demonstrate problem solving using Python language
- Demonstrate principles of object oriented programming in a well-written modular code

Course Outcomes

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

CO1: Understand the given programming language constructs.
CO2: Develop simple programs with scripts and control statements.
CO3: Analyse the structures of list, tuples and maintaining dictionaries.
CO4: Apply advanced libraries for real-time applications.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Introduction to Python: motivation for learning Python in scenarios like rapid prototyping. Installing Python: basic syntax, interactive shell, editing, saving, and running a script. The concept of data types: variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; Conditions, boolean logic, logical operators: ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation.

Unit 2

Working with text files: manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). Lists, tuples, and dictionaries: basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

Unit 3

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Recursive functions. Use of popular Python packages for scientific computing: Exercises to understand usage of libraries like Numpy, SciPy, Pandas, Scikit-learn in interpreted and script modes.

Text Books & References

CO2: Produce great designs, be a more effective engineer, and communicate highly emotionally and intellectually.

CO3: Apply the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices.

CO4: Conceive, organize, lead and implement projects in the interdisciplinary domain and address social concerns with innovative approaches.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Syllabus**

**Design process:** Traditional design, design thinking, existing sample design projects, study on designs around us, compositions/structure of a design.

**Innovative design:** Breaking of patterns, reframe existing design problems, principles of creativity.

**Empathy:** Customer needs, insight-leaving from the lives of others/standing on the shoes of others, observation.

**Conceptualization:** Visual thinking, concept generation methodologies, Concept Selection, Concept Testing, Prototyping.

Design projects for teams

**Text Books / References**


Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons Inc

Brenda Laurel Design Research methods and perspectives MIT press 2003


Stuart Pugh, Total Design: Integrated Methods for Successful Product Engineering,

Bjarki Hallgrimsson, Prototyping and model making for product design, 2012, Laurence King Publishing Ltd

Kevin Henry, Drawing for Product designers, 2012, Laurence King Publishing Ltd.
Course Objectives

- To impart knowledge on fundamental concepts of metallic materials behaviour and crystal structures
- To inculcate the theory of fracture mechanics, fatigue and creep properties
- To facilitate an understanding of various strengthening mechanisms, heat treatment, for specific materials and requirements.
- To familiarize with the properties and applications of non-ferrous materials, composite materials, and advanced materials.

Course Outcomes

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

CO1: Analyze the structure and mechanical properties of engineering materials and apply them to engineering problems

CO2: Assess different types of ferrous and non-ferrous materials and determine the appropriate material for the given application

CO3: Investigate the effects of heat treatment on microstructures and mechanical properties

CO4: Understand the characteristics and applications of advanced materials and material selection concepts for Robotics.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3

Lab Components:
Text Books

References
Pre-requisite: Knowledge on Engineering Mechanics

Course Objectives
- To familiarize with fundamental definitions and classification of mechanisms.
- To enable the students to perform kinematic synthesis and analysis of planar mechanisms with lower and higher pairs.
- To impart knowledge on dynamic analysis and balancing of masses.
- To familiarize with mathematical modelling and analysis of mechanical vibration systems.

Course Outcomes
At the end of the course, the student will be able to:
- CO1: Apply the fundamentals of mechanisms to design mechanisms and machines.
- CO2: Perform kinematic analysis and synthesis of planar mechanisms.
- CO3: Perform kinematic analysis of cams, gears and gear trains.
- CO4: Estimate the magnitude and position of balancing masses for unbalanced rotating parts.
- CO5: Formulate the dynamic equilibrium equations of free longitudinal, transverse and torsional vibration systems and solve them.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Kinematics Analysis of Mechanisms: Displacement, velocity and acceleration in simple planar mechanisms - Graphical method (Relative velocity method) - Coriolis component of acceleration.

Synthesis of Mechanisms: Types of synthesis - Three-position synthesis of planar mechanisms - Freudenstein equation.

Unit 2
Kinematics of Cams: Classification of cams and followers, nomenclature – Cams with different follower motions.


Unit 3
Static force analysis – Analytical / graphical approach : Calculation of stalling and dynamic torque in robot manipulators; selection of Gear boxes / reducers in robot manipulators


Lab Component
- Identification of kinematics links, pairs, and chains in a mechanism & demonstration of various mechanisms using MAKIT - MASTER Mechanisms Kit and MAKIT - HITECH Controller Kit.
- Using ADAMS software, modelling and analysis of various planar mechanisms viz. slider-crank mechanism and its inversions, four-bar mechanism and its inversions, 6-bar chains, crank and slotted lever and Whitworth quick return mechanisms.
- Analysis of cam profiles
- Free vibration of spring-mass system
- Critical speed of shafts
- Bifilar, trifler and compound pendulums

**Text Books**


**Reference Books**


Course Objectives
- Introduction of electrical and non-electrical actuators.
- Sizing of pneumatic and hydraulic actuators.
- The terminology, characteristics and construction of electrical actuators.
- The classification of electric drives and their performance characteristics.
- Selection of actuators and drives for robotics and automation applications.

Course Outcomes
At the end of the course, the student will be able to
CO1: Understand the concepts of hydraulic, pneumatic and electrical actuators to industrial applications.
CO2: Determine the specifications of hydraulic, pneumatic actuators for a given application.
CO3: Evaluate the performance characteristics of electrical actuators.
CO4: Select suitable actuators and drives for robotics and automation applications.
CO5: Analyze the performance characteristics of drives for different actuators.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Introduction to Electrical actuators, Solenoids, Rotating electrical machines, operating principles, main terminology and industrial standards. DC, Synchronous, Induction, Stepper, BLDC, Servo motor: principle of operation, main characteristics and construction, Types, Starting, Speed Control and braking, Efficiency, Testing, Selection considerations.

Unit 3

Text / Reference Books
Course Objectives
- To enable the students to differentiate between 8051 and ARM Cortex-M4 microprocessor.
- To explore embedded C programming for configuring various peripherals of a microcontroller.
- To acquire knowledge to develop microcontroller-based solutions for solving real world problems.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the basics of microcontroller and to program 8051 microcontroller.
CO2: Identify the advanced features of Cortex M4 processor.
CO3: Analyse STM32F4 peripherals and its configuration using embedded C.
CO4: Design and develop embedded systems using 8051 and STM32F4 microcontrollers.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO8</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to Embedded Systems; Architecture – Sensors, Processor: Microprocessor & Microcontroller, Actuator; Classifications of embedded systems; Design process; Applications; Processor - evolution and types. CPU Performance, Performance Metrics and Benchmarks.

Unit 2
An introduction to Embedded Processors. ARM Architecture – Programmer’s Model, Instruction Set, Addressing modes, Assembly Programs. Pipelined data path design - Pipeline Hazards. Memory system design- Cache Memory, Memory Management unit, Virtual Memory.

Unit 3

Lab Components
1. Familiarization of IDE, simulator, development boards and kits
2. Assembly Language Programs
3. Embedded C Program to configure and use Input/output ports & Timers
4. Embedded C Program to configure and use ADC and DAC
5. Embedded C Program to configure and use PWM
6. Embedded C Program to configure and use UART
7. Embedded C Program to configure and use SPI
8. Embedded C Program to configure and use I2C
9. Interfacing of sensors and actuators to microcontroller
10. Development of robotic and automation applications

Text Books

References
2013.
Course Objectives
Through a study of the Rāmāyaṇa, the student should gain a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

Course Outcomes
At the end of the course the student will be able to
CO1: Appreciate the significance of Rāmāyaṇa as an itihāsa, and important aspects of Bālakāṇḍa.
CO2: Understand the family values and ideal human relationships portrayed in the Ayodhyakāṇḍa and Aranyakāṇḍa of Rāmāyaṇa.
CO3: Understand dharma and its nuances, emphasizing its applicability in an individual’s life through Kishkindhakāṇḍa and Sundararākāṇḍa of Ramayana.
CO4: Appreciate the triumph of dharma over adharma through Yuddhakāṇḍa of Rāmāyaṇa
CO5: Appreciate the spiritual values from Rāmāyaṇa in resolving personal and social conflicts through varied effective presentations of important episodes of the Rāmāyaṇa.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
An overview of Valmiki’s epic. Introduction to the content and structure of the epic text and it’s principal characters.
Bala-Kāṇḍa: Preparing for the renowned mission.

Unit 2
Aranya-Kāṇḍa: Tale of the forest life.

Unit 3
Kishkindha-Kāṇḍa: The Empire of Holy Monkeys.
Sundara-Kāṇḍa: Heart of the Ramayana

Unit 4
Yuddha-Kāṇḍa: The most popular part of the Ramayana
Uttara-Kāṇḍa: An attempt to explain the untold stories.

Unit 5
Ramayana and Modern-day learning
Ecological Awareness in the Ramayana
Different Ramayana: Epic that connects the world.

Text Books / References
Leadership Lessons from the Ramayana, ASCSS
Rajagopalachari, C, The Ramayana
Valmiki, The Ramayana, Gita Press

Course Objectives
- To know about Indian constitution.
- To know about central and state government functionalities in India
- To know about Indian society

Course Outcomes
At the end of the course, the student will be able to:
CO1: Understand the functions of the Indian government
CO2: Understand and abide the rules of the Indian constitution
CO3: Understand and appreciate different culture among the people

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Historical Background – Constituent Assembly Of India – Philosophical Foundations Of The Indian Constitution


Unit 2
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister
– Cabinet – Parliament – Supreme Court of India – Judicial Review.

Unit 3

Text Books
Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

Reference Books

Pre-requisite: An open mind and the urge for self-development, basic English language skills, knowledge of high school level mathematics.

Course Objectives
- Assist students in inculcating Soft Skills and developing a strong personality
- Help them improve their presentation skills
- Support them in developing their problem solving and reasoning skills
- Facilitate the enhancement of their communication skills

Course Outcomes
CO1 - Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.
CO2 - Soft Skills: To empower students to create better impact on a target audience through content
creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.

**CO3 - Aptitude:** To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.

**CO4 - Aptitude:** To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.

**CO5 - Verbal:** To infer the meaning of words and use them in the right context. To have a better understanding of the basics of English grammar and apply them effectively.

**CO6 - Verbal:** To identify the relationship between words using reasoning skills. To develop the capacity to communicate ideas effectively.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Syllabus**

**Soft Skills**

**Soft Skills and its importance:** Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback. Need for change in mindset and up-skilling to keep oneself competent in the professional world.

**Managing Self:** Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up-gradation / Life-long learning. Personal productivity - Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.

**Aptitude**

**Problem Solving I**

**Numbers:** Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.

**Percentage:** Basics, Profit, Loss & Discount, and Simple & Compound Interest.

**Ratio, Proportion & Variation:** Basics, Alligations, Mixtures, and Partnership.

**Averages:** Basics, and Weighted Average.

**Data Interpretation:** Tables, Bar Diagrams, Venn Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, Network Diagrams and other forms of data representation.

**Verbal**

**Vocabulary:** Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misused words, commonly confused words and wrong form of words in English.

**Grammar (Basic):** Help students learn the usage of structural words and facilitate students to identify errors and correct them.

**Reasoning:** Stress the importance of understanding the relationship between words through analogy questions.

**Speaking Skills:** Make students conscious of the relevance of effective communication in today’s world through various individual speaking activities.

**References:**

5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan’s – GRE Comprehensive Programme
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

### Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Assessment (CA)* – Soft Skills</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Aptitude</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Verbal</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

*CA - Can be presentations, speaking activities and tests.
Pre-requisite: Mathematics for Intelligent Systems 3 (knowledge requirement)

Course Objectives
- To lay down the basic concepts and techniques of linear algebra, calculus and basic probability theory needed for subsequent study.
- To explore the concepts initially through computational experiments and then try to understand the concepts/theory behind it.
- To provide an appreciation of the wide application of these disciplines within the scientific field.
- To provide connection between the concepts of linear algebra, differential equation and probability theory.

Course Outcomes
At the end of the course, the student will be able to:

CO1: Illustrate the basic concepts and techniques of linear algebra, calculus and basic probability theory needed for AI.

CO2: Integrate the application of these disciplines within the scientific field.

CO3: Develop an insight into the applicability of linear algebra in business and scientific domains.

CO4: Apply the concepts of calculus and linear algebra in modelling electrical and mechanical elements.

CO5: Apply the concepts of probability theory for building datasets for computational experiments in data science.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus


Probability and statistics – 4 - Basics of statistical estimation theory and testing of hypothesis. Design of Experiments.

Lab Practice: Computational Exercises related to topics discussed in the course.

Text Books / References
Course Objectives
 To familiarize the primary tools for exploration, visualizations, and descriptive statistics, for prediction are machine learning and optimization, and for inference are statistical tests and models.
 To train the students to ask appropriate questions about their data and correctly interpret the answers provided by inferential and computational tools through understanding of a particular domain.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Summarize the statistical foundations of data science.
CO2: Apply pre-processing techniques over raw data so as to enable further analysis.
CO3: Conduct exploratory data analysis and create insightful visualizations to identify patterns.
CO4: Apply the data clustering techniques in various case studies.
CO5: Analyze the degree of certainty of predictions using statistical test and models.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Descriptive statistics – Central tendency, dispersion, variance, covariance, kurtosis, five point summary, Distributions, Bayes Theorem, Error Probabilities; Permutation Testing, Statistical Inference; Hypothesis Testing, Assessing Models, Decisions and Uncertainty, Comparing Samples, A/B Testing, P-Values, Causality.

Unit 3
Estimation, Prediction, Confidence Intervals, Inference for Regression, Classification, Graphical Models, Updating Predictions.

Lab Practice:
Computational Exercises using Programming languages & Application packages

Text Book

Reference Books
To impart the concepts of serial and parallel robotic system, its components, forward and inverse kinematics related to robot manipulators.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the fundamentals of robotics, robot anatomy and components of robot.
CO2: Solve the forward and inverse kinematics problems of serial robot manipulators.
CO3: Compute Jacobian matrix and solve the singularity problems of serial robot manipulators.
CO4: Solve the forward and inverse kinematics problems of parallel robot manipulators.
CO5: Design and simulate the forward, inverse kinematics problem of serial and parallel robot manipulator.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Robot manipulator kinematics, Degrees of freedom, links, joints, Rotation matrix, Euler angles, Homogeneous transformation matrix, D-H parameters, Forward and inverse kinematic problems of 2-link and 3-link robot manipulator, work volume simulation, singularities, analysis of singularities, Robot Exoskeleton, Jacobian, Inverse Jacobian.

Unit 3
Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Inverse kinematics of parallel manipulators and mechanisms, Introduction to direct kinematics of Gough-Stewart platform.

Unit 4
Introduction to Robot Programming Languages, Joint and Cartesian Motion Planning, Offline and Online Simulation of Industrial Robots, Robotic applications such as pick-and-place, assembling, welding, painting, etc.

Text Books

Reference Books
Pre-requisite: Mathematics for Intelligent Systems 1 (Knowledge level)

Course Objectives
- To impart the knowledge of the mathematical modelling of control systems.
- To familiarize the concept of stability of control systems.
- To familiarize the design control strategies for different applications.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Develop the mathematical model of the physical systems to design the control systems.
CO2: Analyze the response and stability of the closed and open loop systems.
CO3: Design and analyze the different kinds of compensator and state space models.
CO4: Design controllers based on stability and performance requirements.
CO5: Design and develop control algorithms for physical systems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO7</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO8</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO9</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO10</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO11</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO12</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PSO2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PSO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus
Unit 1

Unit 2

Unit 3

Text Books

Reference Books
22MEE216 MANUFACTURING PROCESSES L-T-P-C: 2-0-3-3

Course Objectives
- To impart the fundamental concepts in casting, forming, and joining process.
- To enable preparation of sand mould with proper gating and riser system.
- To provide basic skills in performing TIG / MIG welding process with the preparation of weld joints.
- To familiarize the forming processes such as deep drawing, blanking, piercing and power calculation.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Understand the principle of metal casting process and select a suitable casting process for manufacturing products for various applications
CO2: Understand the deformation mechanism of different metal forming processes and appreciate their applications to develop various shapes and features
CO3: Select and perform a suitable welding process based on the given material and geometry.
CO4: Identify various casting, welding, and forming defects and provide remedies to prevent such defects.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus
Introduction to manufacturing processes, classifications.

Casting processes: Introduction to sand casting process- principle, process parameters, classifications, casting equipment and tools, moulding, melting, pouring, finishing processes -defects- other casting processes- applications and limitations.

Bulk and sheet metal forming processes: Introduction, types of forming processes, development drawing of simple sheet metal object, sheet forming processes – equipment and tools, process parameters, characteristics, defects, applications and limitations.

Metal joining processes: Gas welding, arc welding, resistance welding, solid state joining, brazing and soldering, processes – Principles, equipment, process parameters, tools and accessories, joint characteristics, defects, applications and limitations.

Lab Practice:
Metal Casting: preparation of mold; melting & casting of non-ferrous materials; Casting defect studies
Metal Forming: Metal forming operations using hydraulic & mechanical press (demonstration), Sheet metal layout design and Forming load calculations
Metals Joining process: Hands on practice on TIG and MIG welding processes; Robotic Welding; Welding defect studies
**Text Books**

**Reference Books**
Lab Manual (Internal)
Robot Kinematics lab

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the fundamentals of robotics, robot anatomy and components of robot.
CO2: Solve the forward and inverse kinematics problems of serial robot manipulators.
CO3: Compute Jacobian matrix and solve the singularity problems of serial robot manipulators.
CO4: Solve the forward and inverse kinematics problems of parallel robot manipulators.
CO5: Design and simulate the forward, inverse kinematics problem of serial and parallel robot manipulator.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus (Robot Kinematics Lab)
Students must be trained hands-on in designing and simulating the forward, inverse kinematics based on D-H conventions using MATLAB, ADAMS / RoboAnalyzer, MechAnalyzer, and GIM. The list of experiments to be followed but not limited to.

- Study of different types of robots based on configuration, number of joints and links.
- Study of components of robots with actuators and end effectors
- Visualization of D-H convention and maximum-minimum reach of manipulators
- Singularity analysis using Robot simulator
- Development of a work object for Industrial Robot using Robot simulator
- Verification of transformation (position and orientation) with respect to gripper
- Estimation of accuracy, repeatability, and resolution.
- Study of the various designs of serial manipulator with R and P configurations for 3, 4, 5 and 6 degrees of freedom robot manipulators
- Simulation of robot work volume based on D-H conventions
- Kinematic architecture and modeling of various robot Exo-skeletons
- Design and Motion study of Stewart platform using various configurations (Spherical, Planar, Rotation)
- Draw the work envelope for Five bar closed loop mechanisms (Parallel Manipulator)
- Joint and Cartesian Motion Planning on Industrial Robot
Control System Lab

Course Outcomes (Control System Lab)
At the end of the course, the student will be able to:
CO1: Develop the mathematical model of the physical systems to design the control systems.
CO2: Analyze the response and stability of the closed and open loop systems.
CO3: Design and analyze the different kinds of compensator and state space models.
CO4: Design controllers based on stability and performance requirements.
CO5: Design and develop control algorithms for physical systems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus
Lab Components:
The following lab exercises are performed to understand the closed-loop feedback control systems, transient response, steady state response, PID controllers, and stability.
1. QNET Rotary Inverted Pendulum
2. Mechatronic Systems Board for position control
3. QNET DC Motor Control Trainer
4. Coupled Tanks
5. QNET Vertical take-off and landing trainer
6. Flow and Level control
7. MATLAB control system Toolbox
8. Ball and Beam system control for stability analysis
9. 2 DOF Ball Balancer for stability analysis

Reference Books
Lab manuals
Pre-requisite: An inquisitive mind, basic English language skills, knowledge of high school level mathematics.

Course Objectives
- Assist students in inculcating Soft Skills and developing a strong personality
- Help them improve their presentation skills
- Aid them in developing their problem solving and reasoning skills
- Facilitate them in improving the effectiveness of their communication

Course Outcomes
CO1 - Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.
CO2 - Soft Skills: To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.
CO3 - Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.
CO4 - Aptitude: To analyze and apply suitable techniques to solve questions on logical reasoning and data analysis.
CO5 - Verbal: To learn to use more appropriate words in the given context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.
CO6 - Verbal: To be able to read texts critically and arrive at/ predict logical conclusions. To learn to organize speech and incorporate feedback in order to convey ideas with better clarity.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus

Soft Skills

Communication: Process, Language Fluency, Non-verbal, Active listening. Assertiveness vs. aggressiveness. Barriers in communication. Digital communication

Presentations: Need, importance, preparations, research and content development, structuring and ensuring flow of the presentation. Ways and means of making an effective presentation: Understanding and connecting with the audience – using storytelling technique, managing time, appropriate language, gestures, posture, facial expressions, tones, intonations and grooming. Importance of practice to make an impactful presentation.

Aptitude

Problem Solving II
Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.
Logarithms, Inequalities and Modulus: Basics


Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks.
Logical Reasoning: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives.
Verbal

**Vocabulary**: Aid students learn to use their vocabulary to complete the given sentences with the right words. Usage of more appropriate words in different contexts is emphasized.

**Grammar (Basic-intermediate)**: Help students master usage of grammatical forms and enable students to identify errors and correct them.

**Reasoning**: Emphasize the importance of avoiding the gap (assumption) in arguments/statements/communication.

**Reading Comprehension (Basics)**: Introduce students to smart reading techniques and help them understand different tones in comprehension passages.

**Speaking Skills**: Make students be aware of the importance of impactful communication through individual speaking activities in class.

**Writing Skills**: Introduce formal written communication and keep the students informed about the etiquette of email writing.

**References**:  
5. The hard truth about Soft Skills, by Amazon Publication.  
6. Verbal Skills Activity Book, CIR, AVVP  
7. English Grammar & Composition, Wren & Martin  
8. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce  
9. Cracking the New GRE 2012  
10. Kaplan’s – GRE Comprehensive Programme  
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Assessment (CA)* – Soft Skills</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Aptitude</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Verbal</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

*CA - Can be **presentations, speaking activities and tests.**
Course Objectives

Through a study of the Mahabharata, the student should gain a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

Course Outcomes

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

CO1: Understanding the impact of itihasas on Indian civilization with a special reference to the Adiparva of Mahabharata.

CO2: Enabling students to importance of fighting adharma for the welfare of the society through Sabha and Vanaparva.

CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas.

CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Saupitaka Parvas.

CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Introduction and Summary of the Mahabharata
A Preamble to the Great Itihasa
Unbroken Legacy

Unit 2

Dharmic Insights of a Butcher
The Vows We Take
Kingship and Polity Acumen

Unit 3

Karna – The Maestro that Went Wide off the Mark
Tactics of Krishna
Yajnaseni

Unit 4

Popular Regional Tales
Maha Prasthanam – The Last Journey.

Unit 5

Mahabharata - An All-Encompassing Text
Mahabhara- Whats and WhatNots
Nyayas in Mahabharata

Text Books / References:
Leadership Lessons from the Mahabharat, ASCSS
Rajagopalachari. C, The Mahabharata

SEMESTER 5

23MAT307 GRAPH THEORY ALGORITHMS FOR ROBOTICS L-T-P-C: 2-0-3-3

Course Objectives

- To impart the basic knowledge of graph theory.
- To familiarize the concepts of various types of graphs and simple properties.
- To familiarize with basic results in graph algorithms and apply to networks for robotics.
Course Outcomes
At the end of the course, the student will be able to:
CO1: Apply the concepts of graph theory, shortest path and spanning tree algorithms for real-time problems.
CO2: Apply the graph connectivity algorithms for flow problems in robotic networks.
CO3: Apply the graph spaces and methods in obstacle avoidance.
CO4: Apply the graph theory algorithms for robot motion and path planning.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Graphs and Sub graphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, Paths and Circuits, Components and Connectedness algorithms, shortest path algorithm.

Tree: Trees, properties of trees, Pedant vertices in a tree, center of a tree, rooted binary trees, spanning trees and minimal spanning tree algorithms, Tree traversals. Graph connectivity: Graph connectivity, maximal flow algorithm. Euler and Hamiltonian graphs. Travelling salesman algorithm. Network flow problems, Ford-Fulkerson algorithm.

Planar Graph: Planar graph, Euler theorem and applications of planar graphs. Coloring of graphs.

Lab Practice: Graph theory applications in robotics motion and path planning, collision and obstacle avoidance.

Text Books / References
Stanisław Zawiślak, Jacek Rysiński, Graph-Based Modelling in Engineering: 42 (Mechanisms and Machine Science), Springer, 2018.
Narsingh Deo, Graph Theory with Applications, PHI, 2008
Course Objectives
- To familiarize the student with basic skills useful in identifying the concepts of automation using hydraulics, pneumatics, industrial sensors, PLC and distributed control strategies.
- To inculcate the required skills in designing fluid power system circuits.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Identify and explain the automation need, type and method.
CO2: Demonstrate the functioning of fluid power components.
CO3: Design and simulate the fluid power circuits for the given application.
CO4: Design and simulate the PLC program for the given application.
CO5: Design, develop and simulate closed loop systems for automation.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Hydraulic and Pneumatic Systems in Automation:

Unit 2

Unit 3
Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Text Books

Reference Books
Pre-requisite: Kinematics of Robotic Systems

Course Objectives
- To familiarize with the mathematical modelling of dynamic analysis and forces of robot manipulators.
- To impart the difficulties in planning and controlling the robot manipulators.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Solve the dynamic problems of the robot manipulators
CO2: Apply existing methods and algorithms for trajectory planning
CO3: Explain available control algorithms and systems for robot motion control
CO4: Design the control schemes for robot manipulators
CO5: Design, develop, and simulate the forward and inverse dynamics followed by trajectory planning of robot manipulators

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Dynamics: Lagrange’s equation kinetic and potential energy, link inertia Tensor, Jacobian inertia tensor, Newton-Euler and Lagrange-Euler Dynamic models, Dynamic model of 2-link and 3-link robot manipulators, Operational space dynamic model. General considerations and trajectory planning. Joint interpolated trajectories, Trajectory Interpolation. Set point tracking. Actuator Dynamics

Unit 2
Control Systems Design in State Space: Design of controllers using root-locus, Pole placement with state feedback, Pole placement with output feedback, Robust control systems.
Multivariable Control Systems: Modeling, analysis, and design of linear multi-input, multi-output control systems, are including both state space and transfer matrix approach, stability analysis of MIMO LTI system, controllability, sterilizability, observability, Realization and Model Order Reduction. Multivariable Control System Design.

Unit 3
Motion Control: The manipulator control problem, Joint space control, computed torques techniques, Near Minimum Time control, feed forward control, Existing control algorithms used in controlling robots, PD control with gravity compensation, inverse dynamics control, Non-linear decoupled feedback control, resolved motion control, Adaptive Control, Robot control of trajectory using programming languages.

Text Books

Reference Books
Course Objectives
- To introduce students to the basic concepts and techniques of Machine Learning.
- To develop skills of using recent machine learning software for solving practical problems.
- To make students familiar with the application of machine learning in robotics

Course Outcomes
At the end of the course, the student will be able to
CO1: Apply pre-processing techniques to prepare the data for machine learning applications
CO2: Implement supervised machine learning algorithms for different datasets
CO3: Implement unsupervised machine learning algorithms for different datasets
CO4: Analyze the error to improve the performance of the machine learning models

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO4</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PO5</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PO6</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PO7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO9</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PO10</td>
<td></td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PO11</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PO12</td>
<td>1</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PSO1</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PSO2</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PSO3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3

Unit 4
Introduction to Neural Networks, Reinforcement learning and generative learning.

Lab Practice : Application of machine learning in robotics & AI – using data sets / case studies

Textbooks

References
Course Objectives
- To familiarize the students with the basic understanding of robot operating system and their architecture.
- To visualize and simulate the robot environment with simulators.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Explain about the basics of ROS and their architectures.
CO2: List the existing ROS commands for interfacing, and establish the communication with the robot.
CO3: Design and simulate the robot in robot simulation software.
CO4: Design and develop hardware software interfacing kernel to modify ROS.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction – The ROS Equation - History - distributions - difference from other meta-operating systems - services - ROS framework - operating system - releases. UNIX commands - file system – redirection of input and output - File system security - Changing access rights – process commands – compiling, building and running commands – handling variables

Unit 2

Unit 3

Lab Components
- Experiment on Creating, building, modifying packages and Writing, building source code and nodes
- Creating and Running Publisher and Subscriber Nodes
- Creating and Running Service Servers and Client Nodes
- Writing and Running the Action Server and Client Node
- Programming experiment on nodes with setting, reading, building, running, displaying parameters list
- Experiment of ROS launch
- Experiment on 3D visualization tool (Rviz)
- Design and development of graphical user interface in ROS environment
- Establish communication between robot client and server, and analysis of data packet loss
- Visualization of robot and their movements in Rviz ROS

Textbooks

Reference Books
FLUID POWER LAB

Course Outcomes

At the end of the course, the student will be able to:
CO1: Demonstrate the functioning of fluid power components.
CO2: Design and simulate the fluid power circuits for the given application.
CO3: Design and simulate the PLC program for the given application.
CO4: Design, develop and simulate closed loop systems for automation.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List of experiments

Students must be trained hands-on in designing, developing, simulating the industrial automation for various manufacturing processes (e.g., sequencing hydraulic press etc.) using Automation Studio / Fluidsim software, Pneumatic and Electro-Pneumatic kits. The list of experiments to be followed but not limited to:

- Design and demonstrate the pneumatic circuits for a given application
- Design the industrial fluid power circuit
- Design of multiple cylinder sequence (cascade method) with timer
- Design of multiple cylinder sequence (cascade method) without timer
- Design of multiple cylinder sequence (cascade method) with pneumatic counter
- Design of electro pneumatic circuit
- Design of electro pneumatic circuit for multiple cylinders sequence
- Design of electro pneumatic circuit with various sensors
- Design of electro pneumatic circuit for multiple cylinders sequence using PLC
- Design the fluid power circuit for Industrial application
- Maintenance and troubleshooting of pneumatic components
ROBOT DYNAMICS & CONTROL LAB

Course Outcomes

At the end of the course the student will be able to:
CO1: Solve the dynamic problems of the robot manipulators
CO2: Apply existing methods and algorithms for trajectory planning
CO3: Apply control algorithms and systems for robot motion control
CO4: Design the control schemes for robot manipulators
CO5: Design, develop, and simulate the forward and inverse dynamics followed by trajectory planning of robot manipulators

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Lab Components

Students must be trained hands-on in designing, developing, simulating the forward and inverse dynamics problems, control algorithms and systems using MATLAB Simulink, and RoboAnalyzer / Gazebo. The list of experiments to be followed but not limited to:

- Dynamic modelling of an industrial robot manipulator
- Inverse and forward dynamics of robot manipulator
- Creating robot joint trajectories
- Trajectory Planning of 3R robot based on 3rd order polynomial trajectory
- Computation of geometric Jacobian for robot manipulator
- Trajectory tracking control of industrial robotic arm using robot manipulator blocks
- Rotational and transform Trajectory analysis of robot manipulator
- Trapezoidal velocity profile Trajectory analysis of robot manipulator
- Simulation of joint space Trajectory tracking of robotic arm
- Visualization of manipulator Trajectory tracking in 3D

Reference Books: Lab manuals

23RAI305 INTRODUCTION TO DRONES L-T-P-C: 1-0-3-2

Course Objectives

- To familiarize the basics of Unmanned Arial Vehicles (Drones) and its broad applications in the age of artificial intelligence.
- To familiarize the basic dynamics of drone based flying system.
- To inculcate provide the knowledge of basic electronic components and their working principles in a drone/ Unmanned Aerial vehicle system.
- To impart the knowledge of how to fly a drone by considering the rules and regulations to the specific country.
Course Outcomes
At the end of the course, the student will be able to:
CO1: Explain the drone / UAV flying regulations specific to India and broad applications in the age of AI.
CO2: Analyse the working principles of different electronic components to build the drone.
CO3: Apply the concept of drone dynamics and different movements during flight.
CO4: Design and develop the UAV flying in the given environment.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Introductions to drones and its applications in the age of AI, Drone regulations specific to India, Basics of drone dynamics for flying - frame types, propellers, types of drones, dynamics specific to quadcopter, Understanding UAV movements (Quadcopter), fly a drone, Introduction to drone electronic components, working principle behind each electronic component, Drone frames and electronic assembly, flying experiments.

Text Books / Reference Books
### CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Syllabus

**Unit 1**
Problem definition, Objectives of Research, Approaches to Research, Importance of reasoning in research. Problem Formulation, Conducting Literature Review.

**Unit 2**

**Unit 3**

**Text Books/ Reference Books**


Course Objectives
- To identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- User Need Assessment through Quantitative and Qualitative Measurements
- To design a solution by integrating Human Centered Design concepts
- To devise proposed intervention strategies for Sustainable Social Change Management

Course Outcome
At the end of the course, the student will be able to:
CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement.
CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal.
CO3: Identify and formulate the research challenges in rural communities.
CO4: Design solutions using human centered approach.

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.

Thematic Areas
- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

Pre-requisite: Willingness to learn, communication skills, basic English language skills, knowledge of high school level mathematics.

Course Objectives
• Help students understand corporate culture, develop leadership qualities and become good team players
• Assist them in improving group discussion skills
• Help students to sharpen their problem solving and reasoning skills
• Empower students to communicate effectively

Course Outcomes
CO1 - Soft Skills: To improve the inter-personal communication and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.
CO2 - Soft Skills: To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.
CO3 - Aptitude: To identify, investigate and arrive at appropriate strategies to solve questions on geometry, statistics, probability and combinatorics.
CO4 - Aptitude: To analyze, understand and apply suitable methods to solve questions on logical reasoning.
CO5 - Verbal: To be able to use diction that is more refined and appropriate and to be competent in spotting grammatical errors and correcting them.
CO6-Verbal: To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus
Soft Skills
Group Discussions: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Aptitude
Problem Solving III
Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.
Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.
Logical Reasoning: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding & Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Verbal
Vocabulary: Create an awareness of using refined language through idioms and phrasal verbs.
Grammar (Upper Intermediate-Advanced): Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.
**Reasoning:** Enable students to connect words, phrases and sentences logically.

**Oral Communication Skills:** Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.

**Writing Skills:** Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

**References:**
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Assessment (CA)* – Soft Skills</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Aptitude</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Verbal</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

*CA - Can be presentations, speaking activities and tests.

---

**SEMESTER 6**

**23MEE316 ADDITIVE MANUFACTURING L-T-P-C: 1-0-3-2**

**Course objectives**
- To provide comprehensive knowledge of the wide range of additive manufacturing processes, capabilities and materials
- To make the students understand the various software tools and techniques that enable advanced/additive manufacturing and personal fabrication.
- To make the students learn to create physical objects that satisfies product development/prototyping requirements, using /additive manufacturing processes.

**Course Outcomes**
At the end of the course, the students will be able to

**CO1:** Demonstrate appropriate levels of understanding on the principles of additive manufacturing processes

**CO2:** Evaluate the suitability of materials for different additive manufacturing processes and applications.

**CO3:** Apply suitable CAD tools for effective interfacing with additive manufacturing systems.

**CO4:** Identify suitable additive manufacturing process, define optimum process parameters, and develop physical prototypes using suitable additive manufacturing systems

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PS01</th>
<th>PS02</th>
<th>PS03</th>
</tr>
</thead>
</table>
Syllabus

Unit 1
INTRODUCTION: METHODS AND SYSTEMS
Classification of additive manufacturing processes. Common additive manufacturing technologies: Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), Stereolithography (SLA), Selective Laser Melting (SLM), Jetting, 3D Printing, Laser Engineering Net Shaping (LENS), Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM), Wire Arc Additive Manufacturing (WAAM), Electro Chemical AM, 4D Printing.
Capabilities, materials, costs, advantages and limitations of different systems.

Unit 2
MATERIAL AND PROCESS EVALUATION
Material science for additive Manufacturing: Mechanisms of material consolidation-FDM, SLS, SLM, 3D printing and jetting technologies. Polymers coalescence and sintering, photo polymerization.

Unit 3
CAD in Additive Manufacturing
AM Software: data formats and standardization, slicing algorithms: uniform flat layer slicing, adaptive slicing, and rasterization, part Orientation and support generation.

Laboratory

References
Course Objectives
- Familiarize with essential elements of robotic locomotion.
- Comprehend challenges in realizing robotic locomotion.
- Familiarize with the concepts of path planning and navigation.
- Impart knowledge on the basics of robot learning and collective robotics.

Course Outcomes
At the end of the course, the student will be able to
CO1: Understand the concepts of mathematical models and motion control methods.
CO2: Apply various models of localization and navigation.
CO3: Analyze locomotion challenges and select motion-planning algorithms.
CO4: Design and develop autonomous mobile robots with obstacle avoidance.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to autonomous robotics, terrestrial and aerial locomotion, mobile robot kinematic models, maneuverability, workspace, and kinematic control. Perception – non-visual sensors and algorithms, computer vision, image processing, feature extraction – interest point detectors, range data.

Unit 2

Unit 3
Planning and Navigation: Path planning. Graph search – Voronoi diagram, deterministic graph search, Dijkstra’s algorithm, A*, D* algorithm, Randomized graph search, Potential field path planning. Obstacle avoidance – Bug algorithm, Techniques viz. bubble band, curvature velocity, dynamic window approach, Schlegel approach, gradient method, etc., Mobile robots in practice, delivery robots, intelligent vehicles, mining automation, space robotics, underwater inspection, etc.

Text Books

Reference Books

Course Objectives
- To explore the neural networks and deep learning architectures.
- To enable students to implement, train and debug deep feed forward neural networks.
- To familiarize the application of convolutional neural networks and RNN for images and image sequences.
Course Outcomes
At the end of the course, the student will be able to
CO1: Describe the architecture and parameters involved in deep neural nets.
CO2: Exhibit the design and usage of Convolutional Neural networks.
CO3: Apply neural networks for sequential models.
CO4: Design Neural networks and implement for real time applications.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Deep Feed forward Networks Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms Dataset Augmentation, Noise Robustness Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training.

Unit 2
Convolutional Networks the Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Unit 3
Sequence Modeling: Recurrent and Recursive Nets Recurrent Neural Networks, Bidirectional RNNs, Encoder Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory.

Lab Component: Specific exercises based on research articles / Case studies / data set for DL/ Robotic application

Text Books
"; 2017.
Course Objectives
- To provide the student with basic skills useful in identifying the concepts of automation using hydraulics, pneumatic and PLC.
- To familiarize with the frame works required in architecture for IoT based Automation.
- To introduce edge computing standards and protocols for IoT.
- To introduce Industry 4.0 its applications

Course Outcomes
At the end of the course, the student will be able to:
CO1: design pneumatic and hydraulic circuits
CO2: program PLC for a given application
CO3: Describe the frameworks required in architecture for IoT based automation
CO4: Apply the edge computing standards and protocols for Industrial IoT
CO5: Develop IoT based automated systems for different applications

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to Automation - Automated manufacturing systems. Sensors and Actuators in Automation - Digital and analog sensors; Fluid power actuators; Control valves; Electrical system elements; Motors drives; Mechanical devices. Pneumatic and Hydraulic systems - Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - sequential circuits - cascade method. Control Using PLCs - Relay logic; Combinational and sequential control, Sequential flow chart, Minimization of logic equations; Ladder logic diagrams; Programmable logic controllers (PLCs); PLC components; Programming; I/O addresses; Timer and counters; A/D conversion and sampling; PLC applications. Introduction to SCADA Experiments: Logical Circuits - Pneumatic and Electro-Pneumatic Circuits, Study of PLC and PLC based Electro-Pneumatic Sequencing Circuits.

Unit 2

Unit 3

Text Books
Reference Books
Course Outcomes
At the end of the course, the student will be able to
CO1: Use of mathematical models and motion control methods.
CO2: Apply various models of localization and navigation.
CO3: Analyze locomotion challenges and select motion planning algorithms.
CO4: Design and develop autonomous mobile robots with obstacle avoidance.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lab Practice:
Students must be trained hands-on in designing, developing, simulating the robot path planning for mobile robots using various techniques using V-Rep (CoppeliaSim), MATLAB, Python. The list of experiments to be followed but not limited to.
1. Design and simulation of a biped robot.
2. MATLAB- Simulink (Simscape)/ Python programming for kinematic control of differential drive vehicle.
3. Line fitting and range data feature extraction.
4. Line-based Kalman filtering for mobile robot localization,
5. Simultaneous localization and mapping based on Extended Kalman Filtering.
6. Simulate a system of collective robots for arbitrary inputs and constraints,
7. Mobile robot path planning with global and local dynamic window approaches.

Reference Book: Lab Manuals
Course Objectives
The Mini Project is a part of the coursework to demonstrate the abilities and specialization of the students. It provides the opportunity for the students to put into practice and develop a prototype/hardware/software solution for a real-world problem in an integrated manner by implementing some of the techniques that have been learned in the previous semesters.
- The mini project should be on Hardware Design integrated software and/or Fabrication in any of the areas in Robotics & AI
- Mini project work can be carried out individually or by a group of a maximum of five students.
- The course progress will be monitored at regular intervals.
- There will be no specific guide for a student or project group. The students must identify the project based on their interest and students can approach any faculty member of the department with a prior appointment if they need any guidance or suggestion.
- There will be a faculty coordinator for this course. Every week, the faculty coordinator will review the progress of the course and evaluate the Continuous Internal Examination (CIE) Components with the help of an additional faculty member.
- The end semester evaluation is based on design, working model, report, presentation, and viva-voce. A panel appointed by the department will review the Semester End Examination (SEE) Components.

Course Outcomes
At the end of the course, the student will be able to
- CO1: Design a hardware solution to a real-life problem/application.
- CO2: Implement the hardware solution by developing a working model/prototype
- CO3: Use software tools required for the design and implementation of hardware solutions.
- CO4: Communicate the designs and work procedure through presentations and reports.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

* Note: Evaluations to be done based on the rubrics (wherever possible) by considering COs defined for the course.
Course Objectives

- To illustrate proposal writing in order to bring in a detailed project planning, enlist the materials required and propose budget requirements.
- To familiarize the concept of CoDesign to ensure user participation in the design process in order to rightly capture user needs/requirements.
- To build and test a prototype to ensure that the final design implementation is satisfies the user needs, feasible, affordable, sustainable and efficient.
- To implement real time project in the village followed by awareness generation and skill training of the users (villagers).

Course Outcomes

At the end of the course, the student will be able to:
- CO1: Learn co-design methodologies and engage anticipatorily to finalise a solution.
- CO2: Understand sustainable social change models and identify change agents in a community.
- CO3: Learn Project Management to effectively manage the resources.
- CO4: Apply lab scale implementation and validation.
- CO5: Prototype implementation of the solution.

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

The students shall visit villages or rural sites during the vacations (after 6th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.

Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

Pre-requisite: Self-confidence, presentation skills, listening skills, basic English language skills, knowledge of high school level mathematics.
- Help students prepare resumes and face interviews with confidence
- Support them in developing their problem-solving ability
- Assist them in improving their problem solving and reasoning skills
- Enable them to communicate confidently before an audience

**Course Outcomes**

**CO1** - Soft Skills: To acquire the ability to present themselves confidently and showcase their knowledge, skills, abilities, interests, practical exposure, strengths and achievements to potential recruiters through a resume, video resume, and personal interview.

**CO2** - Soft Skills: To have better ability to prepare for facing interviews, analyse interview questions, articulate correct responses and respond appropriately to convince the interviewer of one’s right candidature through displaying etiquette, positive attitude and courteous communication.

**CO3** - Aptitude: To manage time while applying suitable methods to solve questions on arithmetic, algebra and statistics.

**CO4** - Aptitude: To investigate, understand and use appropriate techniques to solve questions on logical reasoning and data analysis.

**CO5** - Verbal: To use diction that is less verbose and more precise and to use prior knowledge of grammar to correct/improve sentences.

**CO6** - Verbal: To understand arguments, analyze arguments and use inductive/deductive reasoning to arrive at conclusions. To be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Syllabus**

**Soft Skills**

**Team Work:** Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration skills.

**Leadership:** Initiating and managing change, Internal problem solving, Evaluation and co-ordination, Growth and productivity, Importance of Professional Networking.

**Facing an interview:** Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing (including cover letter, digital profile and video resume), being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.

**Aptitude**

**Problem Solving II**

**Sequence and Series:** Basics, AP, GP, HP, and Special Series.

**Data Sufficiency:** Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

**Logical reasoning:** Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.

**Campus recruitment papers:** Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

**Competitive examination papers:** Discussion of previous year question papers of CAT, GRE, GMAT, and other management entrance examinations.

**Miscellaneous:** Interview Puzzles, Calculation Techniques and Time Management Strategies.

**Verbal**

**Vocabulary:** Empower students to communicate effectively through one-word substitution.

**Grammar:** Enable students to improve sentences through a clear understanding of the rules of grammar.

**Reasoning:** Facilitate the student to tap his reasoning skills through Syllogisms, critical reasoning arguments and logical ordering of sentences.
**Reading Comprehension (Advanced):** Enlighten students on the different strategies involved in tackling reading comprehension questions.

**Public Speaking Skills:** Empower students to overcome glossophobia and speak effectively and confidently before an audience.

**Writing Skills:** Practice formal written communication through writing emails especially composing job application emails.

**References:**

5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. A Modern Approach to Verbal Reasoning – R.S. Aggarwal
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
15. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
18. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Assessment (CA)* – Soft Skills</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Aptitude</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Continuous Assessment (CA)* – Verbal</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

*CA - Can be presentations, speaking activities and tests.
Course Objectives
- To provide fundamental knowledge of CAD/CAM and CIM in manufacturing system.
- To familiarize the application of computer in process planning, cellular manufacturing and flexible manufacturing systems.
- To provide exposure to different types of automatic material handling and storage systems for CIMS.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Understand various elements of CIM in developing various level of automations for manufacturing.
CO2: Provide steps to implement computer aided process planning including resource planning in CIM.
CO3: Analyze the material handling systems for implementing automated materials handling systems.
CO4: Understand various techniques needed to build a data warehouse
CO5: Conceptualize and suggest suitable machine cell layout based on Group Technology and FMS.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –
Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance –
Manufacturing Control– Basic Elements of an automated system – Levels of Automation – Lean Production and
Just-In-Time Production.

Computerised process and resource planning: Process planning – Computer Aided Process Planning (CAPP) –
Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production
Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory
Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP)

Automated material handling and storage: Material functions, types of material handling equipment, analysis of
material handling systems, design of system, conveyor system, automated guided vehicle systems, automated
storage/retrieval systems, caroused storage systems, work in process storage, interfacing handling & storage with
manufacturing, ASRS and Industry 4.0, case studies

Data Warehousing: Data warehouse concepts and architecture, multidimensional representation of a data
warehouse, Data warehouse design principles & Methodologies, Data integration concepts, processes & techniques,
Data integration tools, case studies.

Textbook
Groover, Mikell P. Automation, production systems, and computer-integrated manufacturing. Pearson Education
India, 2016.

Reference Books
Joe Reus, ‘Fundamentals of Data Engineering’, Matt Housley Released June 2022 Publisher(s): O'Reilly Media,
Inc.
Pre-requisite: Deep Learning (Knowledge level)

Course Objectives
- To provide a solid introduction to the field of reinforcement learning.
- To make the students learn about the core challenges and approaches, including exploration and exploitation.
- To make the students well versed in the key ideas and techniques for reinforcement learning.

Course Outcomes
At the end of the course, the student will be able to:

CO 1: Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.

CO 2: Decide if an application problem should be formulated as a RL problem; if yes be able to define it formally (in terms of the state space, action space, dynamics and reward model), state what algorithm (from class) is best suited for addressing it.

CO 3: Implement in code common RL algorithms

CO 4: Describe multiple criteria for analyzing RL algorithms and evaluate algorithms on these metrics

CO 4: Describe the exploration vs exploitation challenge, compare, and contrast at least two approaches for addressing this challenge

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO8</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO10</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Lab Exercise: Reinforcement learning applications to Robotics & AI

Reference / Text Books
Laura Graesser and Wah Loon Keng, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison-Wesley, 2020
Course Objectives
- To familiarize the working principles of a CNC machine tool.
- To inculcate CNC part programming skills through CAM software.
- To provide practices in discrete event simulation modelling of a manufacturing systems
- To analyze the performance of a manufacturing system using work study and lean techniques

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the working principles and various subsystems functions of a CNC Machining center
CO2: Simulate and generate simple G and M code of CNC part programing using CAM software
CO3: Modelling of manufacturing and service systems using discrete event simulation package
CO4: Interpret and analyze the results obtained by the simulation model for performance improvement
CO5: Apply work study principles and lean techniques to improve the performance of a manufacturing system

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CNC LAB EXERCISES
- A study on the working principle, construction, and tooling requirement CNC Machine tool
- Generate G and M Code for manual part programming for a simple part geometry
- Modelling of part geometries and CNC code generation using CAM software for generating
- Simulation of machining process using CAM software.
- Machining of a given component using CNC machine tool using CAM software

SIMULATION OF MANUFACTURING SYSTEMS LAB EXERCISES
- Modelling and analysis of manufacturing and service systems using discrete event simulation package.
- Analysis of simulation output data and fit the data into a suitable distribution.
- Modelling of Flow-shops, Job shops, Assembly shops, FMS, and Kanban Controlled Manufacturing Systems using simulation software
- Simulation and Optimization of a manufacturing system model for productivity improvement
- Time and motion study experiments using simulation software for calculating standard time.
- Study and design of lean assembly lines using LEGO kits.
Course objectives

- To impart the social, economic and administrative considerations that influence the working environment of industrial organizations.
- To familiarize with various materials, processes, products and their applications along with relevant aspects of quality control and recent technical developments.
- To expose students to the engineer’s responsibilities and ethics.
- To upskill students to implement the technical knowledge in the real industrial situations.

Course Outcomes

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

**CO1:** Apply theoretical knowledge and skill sets acquired from the course and workplace in the assigned job function(s).

**CO2:** Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement.

**CO3:** Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Guidelines

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. The internship is to be taken in a phased manner during the summer vacation starting from the end of sixth semester. The students are recommended to pursue the internship at Public Sector Undertaking (PSU) and private companies including MNC’s, Small and Medium scale industries or Research labs/institutes or Academic Institutions. After the completion of the internship, the students are instructed to submit the industry supervisors report according to the prescribed format for the external evaluation. Apart from these, the internal evaluation includes a presentation and report submission.
Course Objectives
- To identify suitable and relevant topics, which can be, developed either through development or research activities and match the level expected of an undergraduate student.
- To identify and collate relevant information pertaining to the project’s requirements from various resources.
- To plan, design and propose a feasible project based on the given timeline.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Identify and define a problem based on the community/industry/research.
CO2: Plan project activities, considering their underlying requirements, constraints and deliverables.
CO3: Design the solution to the identified problem.
CO4: Communicate and document the project work through technical reports and presentations.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Guidelines
The aim of the final year project is to give students opportunity to apply the knowledge they have gained to solve practical engineering problems. By doing so, students will gain knowledge and experience in solving problems systematically thus when they graduate, they will be ready to work as reliable and productive engineers. The project problem may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, etc. or a combination of these.

In project phase 1, students are recommended to conduct an exhaustive literature survey to identify the real-life problems. Based on the literature survey they should formulate the problem statement and identify the methodology utilized to solve the problem. At the end of phase 1 of the project, students will have to document their work in the form of project report in the prescribed form. The final evaluation and viva-voce will be conducted after submission of the final project report. Students have to make a presentation on the work carried out, before the departmental committee, as part of project evaluation.
Prerequisite: Project Phase I

Course Objectives
- Develop the project identified in project phase 1 according to the proposed plan and design.
- Verify and validate the developed projects against the proposed objectives and goals.
- Propose future improvement based on project outcomes.
- Communicate project ideas and final product through technical report and presentation.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Develop and test the solution based on the methodology identified in the final year project phase 1.
CO2: Analyze and discuss the results to draw valid conclusions.
CO3: Demonstrate related deliverables needed to support and present the entire project effectively with written and oral means.
CO4: Understand and practice professional and ethical responsibilities for sustainable development of society in the chosen field of project.
CO5: Communicate and document the project work through technical report and presentations.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Guidelines
The aim of the final year project is to give students opportunity to apply the knowledge they have gained to solve practical engineering problems. By doing so, students will gain knowledge and experience in solving problems systematically thus, when they graduate, they will be ready to work as reliable and productive engineers. The project problem may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, etc. or a combination of these.

In phase 2 of the project work, students are recommended to prove the solution to the identified problem statement and methodology in phase 1. The solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology. The consolidated report along with the developed model to be submitted for the assessment. Project outcome to be evaluated in terms of technical, economic, social, environmental, political and demographic feasibility. The final evaluation and viva-voce will be conducted after submission of the final project report in the prescribed form. Students have to make a presentation on the work carried out, before the departmental committee, as part of project evaluation.
PROFESSIONAL ELECTIVES
Course Objectives
- To familiarize the knowledge of the biological systems with reference to robotic systems.
- To inculcate the development of biologically inspired robotic applications.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Interpret the bio-inspired sensing and formulate the bioinspired motion.
CO2: Differentiate the requirements of soft and hard robotics.
CO3: Analyze the control architecture and behavior with reference to kinematics.
CO4: Evaluate collective and bio-hybrid robotics/create electromechanical robotic system.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3

Text Books /Reference
Course Objectives
- To familiarize the knowledge of the kinematics and dynamics of Humanoid Robots.
- To familiarize the generation of biped walking patterns and control.
- To impart the design of different methods for generation of Whole-Body Motion Patterns.
- To inculcate the methods for simulating humanoid robot dynamics.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Explain the kinematics and dynamics of Humanoid Robots.
CO2: Apply the knowledge of design in generating the biped walking patterns and control.
CO3: Analyze the different methods for generation of Whole-Body Motion Patterns.
CO4: Analyze the methods for simulating humanoid robot dynamics.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction, Kinematics: Coordinate Transformations, Characteristics of Rotational Motion, Velocity in Three-Dimensional Space, Robot Data Structure and Programming, Kinematics of a Humanoid Robot. Zero Moment Point (ZMP) and Dynamics: ZMP and Ground Reaction Forces, Measurement of ZMP, Dynamics of Humanoid Robots, Calculation of ZMP from Robot’s Motion

Unit 2

Unit 3
Generation of Whole-Body Motion Patterns: How to Generate Whole Body Motion, Converting Whole Body Motion Patterns to Dynamically Stable Motion, Remote Operation of Humanoid Robots with Whole Body Motion Generation, Reducing the Impact of a Humanoid Robot Falling Backwards Dynamic Simulation: Dynamics of Rotating Rigid Body, Spatial Velocity, Dynamics of Rigid Body, Dynamics of Link System: Forward and Inverse Dynamics, Featherstone’s Method.

Text/Reference Books
Dragomir N. Nenchev, Atsushi Konno, Teppei Tsujita, Humanoid Robots: Modelling and Control, Butterworth-Heinemann, 2019
Course Objectives
- To familiarize the knowledge of medical robots in computer integrated minimally invasive surgery.
- To inculcate the diverse applications of robotics in surgery.
- To familiarize the importance of robotics in Rehabilitation and medical care.
- To familiarize the methodologies for design of medical robots.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the applications of medical robots in computer integrated minimally invasive surgery.
CO2: Apply the robots in general surgery.
CO3: Apply robots in rehabilitation and medical care.
CO4: Design, develop the methodologies for medical robots.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Types of medical robots: Navigation, Motion Replication, Imaging, Rehabilitation and Prosthetics, State of art of robotics in the field of healthcare; 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.

Unit 2
Applications of Surgical Robotics: Radiosurgery, Orthopedic Surgery, Urologic Surgery and Robotic Imaging, Cardiac Surgery, Neurosurgery, ENT surgery; Robots in rehabilitation: Rehabilitation for Limbs, Brain-Machine Interfaces, Steerable Needles.

Unit 3
Robots in Medical Care: Assistive robots – types of assistive robots – case studies; Design of Medical Robots: Characterization of gestures to the design of robots, Design methodologies- Technological choices – Security

Text/Reference Books
- Achim Schweikard and Floris Ernst, Medical Robotics, Springer, 2015

Course Objectives
- To familiarize the building blocks and principles of marine robotics.
- To impart the knowledge in designing the marine robots.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Summarize the basics elements of marine robots.
CO2: Apply the knowledge of thruster system, trajectory methods to navigate the marine robot.
CO3: Analyze the methods to predict the motion and control the marine robot.
CO4: Design the marine robot replicas from bio-mimetics and bio-inspired systems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to marine robotics and robotics configurations, autonomous underwater glider (AUGs), autonomous underwater vehicles (AUVs), and remotely operated underwater vehicles. Actuation and sensing systems; communication; manipulation; interaction; guidance, navigation and control; and mission control systems.

Unit 2
Algorithms for SLAM, fault detection/tolerance systems; multiple coordinated vehicle; and networked vehicle. Signature detection, analysis, and optimization; sensor networks for radars, sonar and navigation; design of propulsion system; and trajectory measurements and simulations. Design and analysis of thrusters for AUGs/AUVs.

Unit 3
Motion prediction and control system, and co-operative adaptive sampling techniques. Design of variable buoyancy systems for UVs. Design of DCDM based controllers for UVs. Remote sensing and environmental monitoring with AUGs/AUVs, underwater vehicle-manipulator system, bio-mimetic underwater robotics, and bio-inspired robotics systems. Case studies from India, Republic of Korea, Japan and USA.

Text Books

Reference Books

Course Objectives
- To impart the basic knowledge of robot cognition, human brain and neuro transmissions
- To familiarize the concepts of robot cognitive models, robot perceptions and 3D digital reconstruction
- To inculcate the cognitive and intelligent robotic models

Course Outcomes
At the end of the course, the student will be able to:
CO1: Interpret the human psychology, neuroscience and data transmission through nerves.
CO2: Apply the cognitive intelligence and soft computing tool in the robot models.
CO3: Apply the 3D digital reconstruction for the robot perception and map building.
CO4: Integrate the path planning and navigation tools with robot models.
Syllabus

Unit 1

Unit 2

Unit 3
Robot Parameter Display, Program for BotSpeak, Program for Sonar Reading Display, Program for Wandering Within the Workspace, Program for Tele-operation, A Complete Program for Autonomous Navigation.

Text Books

Reference Books

Pre-requisite: Introduction to Drones (Knowledge level)

Course Objectives
- To familiarize with the basic concepts of drones, propellers, and controls of drones.
- To impart the state estimations and path planning of drones.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Solve the kinematics and dynamics of fixed wing drones.
CO2: Solve the kinematics and dynamics of fixed wing drones multi rotor micro drones.
CO3: Design the flight controls of drones.
CO4: Design and develop path planning algorithms for drones.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Syllabus

Unit 1

Unit 2

Unit 3

Text Books

Reference Books
Course Objectives
- To familiarize the student with knowledge of various soft computing tools.
- To impart knowledge regarding the theory and application of fuzzy logic controller design.
- To impart understanding of various Non-linear controller strategies.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Summarize the principles of soft computing tools like neural networks and fuzzy logic.
CO2: Apply neural networks and fuzzy logic for system identification.
CO3: Develop understanding of various non-linear control strategies.
CO4: Design fuzzy logic controllers.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3
Fuzzy Model Based Control - T-S Fuzzy model - Linear Matrix Inequality (LMI) Technique - Fixed Gain state Feedback Controller Design Technique - Variable Gain Controller Design using Single Linear Nominal Plant and each Linear Subsystem as Nominal Plant - Controller Design using Discrete T-S Fuzzy System.

Text Book:

Reference Books:

Course Objectives
- To impart the basic knowledge in optimizing the design and performance of robots in kinematics, dynamics and trajectory modelling.
- To impart the concepts of meta-heuristic algorithms in the optimization of robot manipulators.
Course Outcomes
At the end of the course, the student will be able to:

CO1: Formulate Homogeneous Transformation Matrix (HTM) of rigid body and compute optimal values of Roll, Yaw and Pitch.

CO2: Develop solutions using optimization procedure for the forward kinematics and inverse kinematics of the robot manipulator.

CO3: Compute optimum path and trajectory of the robot using optimization methods.

CO4: Optimize the dimensions of the physical components of the robot using meta-heuristic approaches.

CO5: Identify an appropriate robot type with minimum dimensionality for a given specific task using optimization procedure.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Unit 1
Introduction – traditional gradient based Optimization algorithms – Optimality criterion for unconstrained and constrained optimization problems – Heuristic, Meta-heuristics, and Evolutionary algorithms: selective algorithms specific to robotic applications.

Unit 2

Unit 3

Note:
MATLAB will be used for teaching and learning; Computational exercises – Lab practice

Text/Reference Books
**Course Objectives**
- To familiarize with the principles of nonlinear systems.
- To impart the nonlinear system theory to design control systems.

**Course Outcomes**
At the end of the course, the student will be able to:
**CO1:** Describe the methods for digital image processing and analysis.
**CO2:** Apply the algorithms for vision related tasks.
**CO3:** Analyse in-depth analysis of the digital image data with different image data models, pattern recognition algorithms and learning theory.
**CO4:** Design and develop image processing and machine learning algorithms.

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Syllabus**

**Unit 1**

**Unit 2**

**Unit 3**

**Text Books / References**
Course Objectives

- To impart the basic concepts of cell biology, evolutionary systems, neuroscience and immune systems in relation to robotics.
- To familiarize the connection between biology and robotics and how biology inspires robotics.
- To familiarize the different types of robots developed based on biology.

Course Outcomes

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

CO1: Describe the thermodynamics of nucleation and strengthening mechanisms.
CO2: Analyze metallic, functional, polymer materials, and its processing.
CO3: Evaluate high performance materials and techniques for robotics.
CO4: Analyze structure properties, and performance using advanced material characterization technique.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Advanced metallic materials- Fundamental principles of advanced materials and application of advanced materials to robotics using a multidisciplinary science-based approach. Liquid-solid transformation-Nucleation and kinetics of growth, interface morphologies, non-equilibrium freezing, segregation. Nucleation in the solid state-transformations, diffusion in solid state, diffusion equations for steady state and transient conditions, Strengthening methods and mechanisms.

Structural Materials for Robots – Aluminium, copper, magnesium, steel, nickel and titanium alloys. Recent advances in materials development- Hi-Entropy alloys, functionally gradient materials, shape memory alloys, metallic composite for soft robotics, computational metamaterials.

Unit 2

Composites in robotics- Types of matrices and reinforcements, principles, properties and applications, stretchable elastomeric sensor and ionic polymer for robotics, Kevlar, biodegradable smart materials, macroscopic composites, three-dimensional, periodic cellular architecture. Special processing techniques of material for robotics.

Unit 3


Text Books / References


Course Objectives

- To impart the knowledge of advanced topics of the robot manipulators.
- To inculcate mathematical modelling, numerical analysis and problem-solving techniques of robot manipulators.

Course Outcomes

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

CO1: List and describe the advanced elements of serial and parallel robot manipulators.
CO2: Interpret the algorithms and advanced mathematical formulation of manipulators.
CO3: Apply the mathematical models and algorithms in simulation and analysis.
CO4: Design and develop own robot through analysis, simulation and fabrication.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Review of robot manipulator (Serial and Parallel), D-H convention, Forward and Inverse kinematics, Workspace, Analytical and numerical solutions, vibration isolation.

Unit 2

Redundancy and resolution of redundancy in robots, minimizing joint rotations and cartesian motion, Tractrix based approach (resolution, planar and spatial). Experimental 8-link hyper-redundant manipulator. Dynamic equations of motion, derivation & simulation, Recursive inverse dynamics: Newton-Euler formulation, Articulated body algorithm, Chaos and non-linear dynamics, Pseudo-inverse approach, modal approach for straight and circular trajectory.

Unit 3

Simulation on linear control, motion planning, nonlinear position and force control of 6 DOF robot manipulator, partitioning of tasks. Numerical and analytical solutions, Over-constrained and deployable structures – modelling and analysis, Cable driven & pneumatically actuated flexible robots.

Text Book


Reference Books

M.W.Spong and M. Vidyasagar, “Robot Dynamics and Control”, Wiley India.
Course Objectives:
- Provide a generalized framework for modeling engineering systems through lumped parameter elements.
- Introduce and apply different mathematical tools to analyze models of engineering systems.
- Familiarize the use of software tools for solving engineering problems.

Course Outcomes:
At the end of the course, the student will be able to:
CO1: Develop mathematical models for engineering systems in different domains and derive analogies.
CO2: Analyze first and second-order linear and nonlinear systems in the time and frequency domain.
CO3: Perform system identification for linear time-invariant systems.
CO4: Simulate mathematical models of engineering systems using simulation software.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3
Introduction to linear system identification – time and frequency domain identification – discrete-time input-output models for LTI systems – linear least square parameter estimation.

References:
Doebelin E O, System Dynamics: Modeling, Analysis, Simulation and Design, Marcel Dekker 1998
Course Objectives
- To familiarize big data frameworks and APIs.
- To conceptualize data analysis, various data processing and pipelining strategies.
- To visualize map-reduce computing paradigm.
- To train and impart the skills required for managing and balancing large data clusters.

Course Outcomes
At the end of the course, the student will be able to:
CO 1: Describe the basic data abstraction and imbibe the map-reduce skillset.
CO 2: Apply general data pipelining, design and data analytics solutions.
CO 3: Apply scaling up machine learning techniques and associated computing techniques and technologies.
CO 4: Identify the characteristics of datasets and compare the trivial data and big data for various applications.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Hadoop ecosystem in Brief – Basic Paradigm and system architecture, MapRed and HDFS, Making a small Hadoop cluster – Iterative and non-Iterative batch processing, Data stores, HBASE, HIVE, PIG - New generation Big data using Functional Programming in Scala: Basic Syntax-type inference and static types-function types and value types, closures.

Immutability and immutable types-generics type Parameters-Recursive arbitrary collections – ConsList - Iterative arbitrary collections-Arrays-Tail recursion-factorial example-functional abstractions with examples-square root, fixed point, sequence summations. Higher order functions-MapReduce Template-Pattern Matching syntax. Similar higher order (Cons) List operations on arbitrary Collections-filter, fold, partition, span. Basic entity classes and objects in Scala.
Apache Spark: - Resilient Distributed Datasets - Creating RDDs, Lineage and Fault tolerance, DAGs, Immutability, task division and partitions, transformations and actions, lazy evolutions and optimization - Formatting and housing data from spark RDDs-Persistence. Data frames, datasets, Setting up a standalone Spark cluster-: spark-shell, basic API, Modules-Core, Key/Value pairs and other RDD features, MLlib-examples for bi-class SVM and logistic regression.
Lab Practice: Bigdata Analytics using data sets/case problems – Python/ MATLAB
Text Books


‘Scala for the Impatient’, Cay S. Horstmann, 2nd Edition


Hadoop: The Definitive Guide
Course Objectives

- To impart the concepts of normalization and indexing in RDBMS as why they were required.
- To understand how NoSQL databases work and various ACID and Graph database structures.
- To introduce SQL for query writing and database management.
- To convert query processing to function calls using SparkSQL API and understand their equivalence.
- To familiarize topic based streaming and multi-source data acquisition.

Course Outcomes

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

CO1: Describe RDBMS and basic entity relations, normalization and Functional Dependencies as well as time series and sequence data.

CO2: Select a data model that suits the characteristics of the data.

CO3: Differentiate between a traditional Database Management System and a Big Data Management System.

CO4: Recognize different data elements in your own work and in everyday life problems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus


Introduction to Apache Flink – Graph processing- Introduction to GraphX library. Graph problem examples, PageRank and other graph-based examples. Process methods on multivariate time series using map reduce. Interfacing Spark with sensor devices for data accusations (PMU, Arduino, Raspberry Pi). Pushing data to DataFrames and NoSQL/ACID databases (Cassandra/MongoDB), Some popular file formats for large data sets, Some real case study projects on large scale multi source data warehousing.

Lab Practice: Computational Exercises pertaining to Big Data & DBMS

Text Books


Reference Books

Karau, Rachel Warren.
**Course Objectives**
- To familiarize the leading trends and systems in Natural Language Processing.
- To understand the basic representations used in syntax, the semantics of Natural Language Processing.
- To explore the models used for word/sentence representations for various NLP applications.
- To understand how machine learning and deep learning algorithms are used for Natural Language Processing applications.
- To implement deep learning algorithms in Python and learn how to train deep networks for NLP applications.

**Course Outcomes**
At the end of the course, the student will be able to:
- CO 1: Generate word representation to solve NLP problems.
- CO 2: Implement machine-learning models for NLP.
- CO 3: Implement sequence-to-sequence models for NLP.
- CO 4: Assess NLP models using various evaluation metrics.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Syllabus**
Computational linguistics- Introduction, syntax, semantics, morphology, collocation and other NLP problems.
- Evaluation metrics for NLP models and Visualization Machine learning and deep learning for NLP, Sequence to sequence modelling (Encoder decoder), Attention mechanism, Transformer Networks – BERT.
- A brief introduction to Reinforcement learning for NLP. NLP application introduction- Sentiment Analysis, Machine translation, Question answering, Text summarization.

**Text Books / References Books**
- ‘Foundations of Statistical Natural Language Processing’, Christopher Manning and Hinrich Schütze, MIT press, 1999
Course Outcomes
At the end of the course, the student will be able to:

**CO1:** Explain the acoustics of speech production and perception.
**CO2:** Differentiate the characteristics of different speech sounds
**CO3:** Analyse the time-domain and frequency domain features of the speech signal
**CO4:** Realize various algorithms on AI based speech modelling

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Text Books / Reference Books
Course Objectives

- To familiarize with the concept of condition-based maintenance for effective utilization of machines.
- To impart knowledge of artificial intelligence for machinery fault diagnosis

Course Outcomes

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

CO1: Select the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine.

CO2: Acquire and process sound and vibration signals in a dynamic mechanical system.

CO3: Predict the faulty component in a machine by analyzing the acquired vibration signals.

CO4: Build a classifier model for machine learning based fault diagnosis of rotating machines.

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO6</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Basic Concepts: Machinery failures, basic maintenance strategies, factors influencing maintenance strategies, machine condition monitoring, transducer selection and location, PC interfacing and virtual instrumentation. Vibrations signatures of faults in rotating machines; detection and diagnosis of faults.

Unit 2
Instrumentation and Signal Processing: Types of sensors in condition monitoring: vibration, sound, acoustic emission, temperature, ultrasonic and infrared sensors - Signal processing: basic signal and systems concepts, time domain analysis, frequency domain analysis, time-frequency analysis and wavelets.

Unit 3

Text Books


Reference Books


Course Objectives
The course is aimed at
- To introduce digital twins concepts and their applications in industry.
- To familiarize with trends in discrete industry
- To be acquainted with digital twins in the process industry.
- To elaborate on the advantages and applications of digital twins.

Course Outcomes
CO1: Introduce the concept of Digital Twins in manufacturing the industry.
CO2: Acquire knowledge of Digital Twins and their importance.
CO3: Design Digital Twins for discrete and process industries.
CO4: Analyze the performance of Digital Twins.
CO5: Discover the advantages and applications of Digital Twins.

Syllabus

UNIT 1

UNIT 2

UNIT 3

UNIT 4

UNIT 5
APPLICATIONS OF DIGITAL TWINS: Improvement in product quality, production process, process Safety, identifying bottlenecks and Improve efficiency, achieve flexibility in production, continuous prediction, and tuning of the production process through Simulation, reducing the time to market.

List of Experiments:
1. Exercise on Model development using MATLAB Simulink, Simscape
2. Exercise on Model identification using MATLAB – System Identification
3. Model development using Simscape
4. Fault Diagnosis of rotating elements using Digital Twins
5. Parameter tuning of Digital Twins
6. Digital Twins modeling of the Drilling system
7. Validation and performance optimization of the Digital Twins model of the Drilling system
8. Digital Twins for fan speed control system
9. Develop Predictive Models using Digital Twins
10. Estimate the remaining useful life using Digital Twins

**Textbooks:**
Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019

**Reference Books:**
Course Objectives
- To introduce the basic principles of cloud computing, cloud native application development and deployment, containerization principles, micro-services and application scaling.
- To equip the students to understand major industry players in the public cloud domain for application development and deployment.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Summarize the basic principles of cloud computing.
CO2: Apply cloud native application development for containerization and container orchestration.
CO3: Analyze different types of cloud services – Delivery models, Deployment models.
CO4: Implement different solution approaches in Cloud – containers in public cloud, setting up private cloud and convert monolithic applications to containers.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Distributed Computing Taxonomy – Cluster, Grid, P2P, Utility, Cloud, Edge. Fog computing paradigms; Introduction to Cloud Computing – Cloud delivery models (XaaS), Cloud deployment models (Private, Public, Hybrid); Characteristics of Cloud, Major use cases of Cloud; disadvantages and best practices; Major public cloud players in the market; Security Issues and Challenges; Cloud Native application development – Introduction to JavaScript Cloud native application development.

Unit 2
Public Cloud – Using public cloud for infrastructure management (compute and storage services), Web application deployment using public cloud services, and Deploying container images in public cloud, Overview of cognitive services, Case study on architecting cloud-based solutions for a chosen scenario.

Unit 3
Virtualization – Basics, Cloud vs Virtualization, Types of virtualization. Hypervisor types; Containers – Introduction to dockers and containers, containerization vs virtualization, docker architecture, Use cases, Learn how to build container images, Operations on container images; Kubernetes – Need for orchestration, container orchestration methods, Introduction to Kubernetes, Kubernetes architecture, using YAML file, Running Kubernetes via minikub.

Text Books

Reference Books
Kocher PS. Microservices and Containers. Addison-Wesley Professional; 2018.

Menga J. Docker on Amazon Web Services: Build, deploy, and manage your container applications at scale. PacktPublishing Ltd; 2018.

### Course Objectives
- To introduce basics of application development in smart phone operating systems such as Android.
- To learn techniques for Android application development.

### Course Outcomes
At the end of the course, the student will be able to:
- CO1: Interpret Android programming
- CO2: Develop Android programs
- CO3: Develop mobile applications with cloud services
- CO4: Analyse various services of mobile applications development and its usage

#### CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### Syllabus

**Unit 1**
Introduction to mobile application development platforms, Application development - Layouts, Views, Resources, Activities, Intents, Background tasks, Connecting to the Internet, Fragments, Preferences.

**Unit 2**
User Interaction – input, menu items, custom views, User Experience – themes and styles, lists and adapters, material design, adaptive layouts, accessibility, localization, debugging the UI Storing Data, SQLite database, Sharing Data, content resolvers and providers, loaders to load data.

**Unit 3**
Services, background work, alarms, broadcast receivers, Notification, widgets, location-based services and Google maps. Transferring data efficiently, publishing app, Multiple form factors, sensors, Google cloud messaging, monetizing mobile app.

### Text / Reference Books
At the end of the course, the student will be able to:

**CO1:** Describe the basics of VR and AR.

**CO2:** Determine the motions in real and virtual cases with suitable orientation methods.

**CO3:** List and comprehend the suitable components and devices required for AR.

**CO4:** Conduct an inter disciplinary research in health care and manufacturing system through AR and VR.

### CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Syllabus


### Text Books

*Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016*


### Reference Book

Course Objectives
The course is to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains. The course aims at providing students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques. The course will help students to gauge understanding in essential techniques in protecting Information Systems, IT infrastructure, analyzing and monitoring potential threats and attacks, devising security architecture, and implementing security solutions. The students will also have a wider perspective to information security from national security perspective from both technology and legal perspective.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information.
CO2: Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios
CO3: Identify common trade-offs and compromises that are made in the design and development process of Information Systems
CO4: Demonstrate the use of standards and cyber laws to enhance information security in the development process and infrastructure protection

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>


Open Source/ Free/ Trial Tools: WinAudit, Zap proxy (OWASP), burp suite, DVWA kit.

Malware: Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware’s, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis, Open Source/ Free/ Trial Tools: Antivirus Protection, Anti Spywares, System tuning tools, Anti Phishing. [8 Hrs]


**LIST OF PRACTICALS**
1. Implementation to gather information from any PC’s connected to the LAN using whois, port scanners, network scanning, Angry IP scanners etc.
2. Implementation of Symmetric and Asymmetric cryptography.
3. Implementation of Steganography.
4. Implementation of MITM- attack using wireshark/ network sniffers
5. Implementation of Windows security using firewall and other tools
6. Implementation to identify web vulnerabilities, using OWASP project
7. Implementation of IT Audit, malware analysis and Vulnerability assessment and generate the report.
8. Implementation of OS hardening and RAM dump analysis to collect the Artifacts and other information’s.
9. Implementation of Mobile Audit and generate the report of the existing Artifacts.
10. Implementation of Cyber Forensics tools for Disk Imaging, Data acquisition, Data extraction and Data Analysis and recovery.

**LIST OF SUGGESTED BOOKS**
5. V.K. Pachghare, “Cryptography and Information Security”, PHI Learning
BASKET 4: ADVANCED SENSORS AND COMMUNICATION SYSTEMS

23RA1371  SMART SENSORS  L-T-P-C: 3-0-0-3

Course Objectives
- To familiarize the available physical phenomena behind the operation of different types of sensors and micro systems.
- To design sensors with appropriate electronic interface as a complete system.
- To inculcate the applications of sensors in robotics and automation.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Explain the available physical phenomena behind the operation of different types of sensors and micro systems. CO2: Design the sensors with appropriate electronic interface as a complete system.
CO3: Analyze and apply sensors in robotics and automation.
CO4: Design and fabricate the process of MEMS fabrication.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Unit I

Unit 2

Unit 3

Text Books

Reference Books
Course Objectives
- To familiarize the importance of electronic noses for robots through its anatomy.
- To discuss about different chemo sensors and their signaling conditions.
- To illustrate the pattern analysis for olfaction in electronic noses.
- To enable students to analyze different case studies of electronic nose applications in environment modeling.

Course Outcomes
At the end of the course the student will be able to:
CO1: Describe the basics of electronic noses for robotics olfaction.
CO2: Demonstrate the working principles of different chemo sensors and their signaling conditions.
CO3: Analyze the patterns of electronic noses to predict the odors in robots.
CO4: Review the case studies of electronic nose applications in environment modeling.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO8</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO11</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO12</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction- Olfaction, anatomy, Physiology, and Molecular biology- Chemical sensing in humans and machines- Chemosensory perception and detection – Linear salvation model – Static and Dynamic olfactometry – Environmental chambers- Charm analysis – AEDA – Osme.

Unit 2

Unit 3

Text Books / References
Handbook of Machine Olfaction, Electronic Nose Technology Wiley, 2006
Andrew R Russell, Odour Detection By Mobile Robots, World Scientific Publishing Company, 1999
Electronic Noses and Tongues in Food Science, Elsevier Science, 2016

Course Objectives
- To familiarize the basic of human computer interaction (HCI).
- To impart the basic concepts of models and theories of HCI.
- To enable the students to acquire knowledge to develop the HCI for solving real world problems.
Course Outcomes
At the end of the course the student will be able to:

CO1: Describe the basics of concepts of HCI process.
CO2: Explain the HCI models and theories.
CO3: Analyse the different concepts in existing HCI systems.
CO4: Design and develop HCI using user interface systems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Text Books

Reference Books
Pre-requisite: Machine-to-Machine Communications (Knowledge Level)

Course Objectives
- To illustrate the UAV types and their missions for swarm communication.
- To familiarize the basics of data link communication for UAV.
- To explore the network platforms for UAV based systems.
- To enable students to analyze the security issues and challenges in UAV Networks.

Course Outcomes

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

CO1: Summarize the types of UAV and their missions for swarm communication.
CO2: Describe the basics of data link communication for different interfacing of UAV.
CO3: Enumerate the types of network platforms for UAV based systems.
CO4: Analyze about the security and privacy issues in UAV Networks.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction – UAV Types and Missions – Swarming and Miniaturization- Air to Ground and Air to air data link communication – Air to ground communication for manned aviation – Practical and UAV and MUAV links – Terrestrial wideband solutions.

Unit 2
Aerial Wifi Networks – Characteristics- Communication demands –requirements – Airborne Networks and protocols – Aeronautical protocol architecture – UAV platform systems and UAV Networked systems.

Unit 3
UAV detection and identification – Cellular connected UAVs – Safety security and privacy in UAV.

Text Books / References
UAV Communications for 5G and Beyond, Wiley, 2020.
Hailong Huang, Andrey V. Savkin, Chao Huang, Wireless Communication Networks Supported by Autonomous UAVs and Mobile Ground Robots, Elsevier Science, 2022.
At the end of the course, the student will be able to:

**CO1**: Explain the basic terminologies of cyber vehicle systems.

**CO2**: Summarize the cyber vehicle attacks with different constraints.

**CO3**: Identify the security mechanisms for cyber vehicle attacks.

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Syllabus**


**Text Books**


**Reference Book**

Course Objectives
- To introduce the evolution of intelligent transport systems.
- To familiarize with communication technologies and business models for connected vehicles.
- To inculcate the beam forming and signal design strategies for connected vehicles.
- To enable the students to analyze the security issues and challenges in connected vehicles.
- To explore the regulations of connected vehicles.

Course Outcomes
At the end of the course, the students will be able to:
CO1: Summarize the evolution of intelligent transport systems for automated driving.
CO2: Apply the communication technologies and business models for connected vehicles.
CO3: Analyze the beam forming and signal design strategies for connected vehicles.
CO4: Summarize the security issues and challenges in connected vehicles.
CO5: Describe the regulations of connected vehicles.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Introduction- Intelligent transport system- Connected and automatic driving- Communication technologies for V2x- Business models – standards and regulations for V2x -3GPP- IEE and SAE- 5GPP – EATA- V2x in 5G.

Text Books / References
Cellular V2X for Connected Automated Driving, Wiley, 2021
Self-Driving Vehicles and Enabling Technologies, IntechOpen, 2021
Introduction to Self-Driving Vehicle Technology, Hanky Sjafrie, CRC Press, 2019

Course Objectives
- To familiarize the telecommunication and computer network technologies.
- To illustrate the communication process through OSI layer architecture and its functionalities.

Course Outcomes
At the end of the course the student will be able to:
CO1: Describe the elements of networks and their entities.
CO2: Identify the error and its correction mechanisms for different medium.
CO3: Summarize the routing protocols to find the shortest path in network communication.
CO4: Describe the principles of connectionless and connection-oriented protocols.
CO5: Apply the socket programming concepts for end user applications.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

**Introduction to Computer Networking Concepts:** Layered Network Protocol Architectures; Personal, Local, Metropolitan and Wide Area Networks; Telecommunications and Cellular Networks overview.

**Physical Layer:** Basics of communications; Physical media types and their important bandwidth and bit-error-rate characteristics; Wired and Wireless media including copper cables, optical fiber and wireless.

**Data Link Layer and Logical Link Control (LLC) sub-layer:** Framing; Error control including Bit-parity, CRC and Hamming Codes; Reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat. Performance analysis of ARQ protocols. Example protocols such as HDLC and PPP. Medium Access Control (MAC) sub-layer: Shared media systems; Bus, Star and Ring topologies; TDMA, FDMA, CSMA, CSMA/CD, Ethernet and IEEE 802.3; IEEE 802.11 including CSMA/CA protocols; Performance analysis; Shared and Switched Ethernet; Related protocols such as ICMP, NAT, ARP and RARP.

**Network Layer:** Internet Protocol (IP) suite; Hierarchical network architectures; IPv4 and IPv6 addressing and headers; Routing protocols including distance-vector and link-state approaches; Interior and Exterior Gateway Protocol concepts; Routing Algorithms including Dijkstra’s algorithm and distributed Bellman-Ford algorithm; Example protocols: OSPF, RIP, BGP.

**Transport Layer:** Reliable end-to-end transmission protocols; UDP header; Details of TCP header and operation including options headers and congestion control; TCP variants such as Reno, Tahoe, Vegas, Compound and CUBIC.

**Application Layer:** Socket Interface and Socket programming; Example protocols such as DNS, SMTP, FTP, and HTTP.

**Text Books**


Course Objectives
- To impart the fundamental concepts in powder metallurgy.
- To familiarize various nontraditional machining processes and advanced inspection systems.
- To introduce the advanced machining and finishing processes like CNC, micro and nanomachining processes, abrasive finishing processes etc.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the need of powder metallurgy and the steps involved in manufacturing a powder metallurgy component.
CO2: Apply the knowledge on various energy based non-traditional machining processes and suggest a suitable process based on the situations.
CO3: Develop programming skills to generate or edit a CNC program emphasis to G and M codes.
CO4: Identify and estimate measurement errors and suggest suitable techniques to minimize them.
CO5: Select a specific Material addition, Micro and Nano and super finish process.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Powder metallurgy: Stages in powder metallurgy - production of metal powders - characteristics of metal powders - mixing of metallic powders - compaction - mechanism of sintering - applications. Impregnation and Infiltration Advantages, disadvantages and specific applications of P/M.

Non-conventional machining processes: Comparison between traditional and non-traditional machining process. Abrasive Jet Machining, Electrical Discharge Machining, Electrochemical Machining, Ultrasonic Machining, Laser Beam Machining, Electron Beam machining. Introduction to Rapid Prototyping & Rapid Tooling, Green manufacturing.

CNC machines: Overview, types, construction, tool and work holding devices, feedback devices, part programming - examples. Data exchange between CAD/CAM - Concepts of native and neutral file formats for data exchange, Interfacing with manufacturing systems. Computer aided process planning


**Material addition process**: Rapid prototyping, stereo-lithography, selective laser sintering, 3D Printing, fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, laser welding, LIGA process.

**Micro & Nano machining process**: Diamond turn mechanism, material removal mechanism, applications. Concepts of reverse engineering.

**References:**
Course Objectives
 To impart knowledge on the fundamentals of high precision measurements, laser metrology and Coordinate Measuring Machine (CMM).
 To facilitate an understanding on functioning and applications of machine vision system for quality control.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Apply the various methods of high precision measurements and Ultrasonic techniques.
CO2: Apply the methods of laser interferometry, Atomic Force techniques to measure surface topography and interpret the results.
CO3: Apply suitable programming commands to measure the critical features of a component using CMM.
CO4: Select suitable Machine Vision system for image acquisition, processing and interpret the results for on-line quality control.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3
Edge detection techniques, Normalization, Grey scale correlation – Reflectance map concepts; surface roughness and texture characterization - photogrammetry. Application of Machine Vision in inspection - Measurement of length, diameters, and Surface roughness - automated visual inspection - 3D and dynamic feature extraction. On-line Quality control: On-line feedback quality control variable characteristics - control with measurement interval, one unit, and multiple units control systems for lot and batch production.

Text Books

Reference Books
John A. Bosch, Giddings, and Lewis Dayton - ‘Coordinate Measuring Machines and Systems’ - Marcel Dekker
Course Objectives
- To provide the concept of smart manufacturing systems
- To familiarize various methods by which the smart manufacturing implemented
- To provide case studies on implementation of Smart manufacturing in various industries

Course Outcomes
At the end of the course, the student will be able to:
CO1: Explain the principles of smart manufacturing.
CO2: Describe the various elements of Smart Manufacturing and its role in the system.
CO3: Apply different model driven approach for sustainable and smart manufacturing.
CO4: Evaluate the trends and issues in implementing smart manufacturing through case studies.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to Smart Manufacturing, Smart Sensors and Smart Tooling, Smart machines and intelligent machining, digital and smart factories, implementing smart manufacturing across an industrial organization, cyberinfrastructure for the democratization of smart manufacturing, the role of hardware and software in smart manufacturing Infrastructure changes, Reinvigorating the manufacturing workforce, benefits of smart manufacturing to value chain.

Unit 2
Measuring, managing, and transforming data for operational insights, the role of advanced process modelling in smart manufacturing, Industrial AI and predictive analytics for smart manufacturing systems, A systems engineering-driven decomposition approach for large-scale industrial decision-making processes, Model-predictive safety: A new evolution in functional safety, Inferential modelling and soft sensors, A decision support framework for sustainable and smart manufacturing.

Unit 3

Text Books / Reference Books
Course Objectives
- To introduce the concepts of micro and nano electromechanical devices.
- To familiarize the fabrication process of Microsystem.
- To provide information on various nanofabrication techniques currently in practices.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Interpret the basics of micro/nano electromechanical systems including their applications and advantages.
CO2: Identify and describe micro fabrication technique based on the materials and applications.
CO3: Apply the knowledge of micro/nano sensors and actuators in development of MEMS/NEMS.
CO4: Choose appropriate nano fabrication process based on various principles like various etching, lithography, template and other advanced techniques.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Unit 1

Unit 2

Unit 3
Nano Electro Mechanical Systems (NEMS) Introduction- Nano machining of NEMS based lithography techniques, Nano electromechanical systems fabrication, nano imprint lithography, polymeric nano fibre templates, focused ion beam doping and wet chemical etching, stencil lithography and sacrificial etching. Scanning-probe techniques, Scanning-probe techniques, Self-assembly for NEMS, nanometrology and applications of nano sensors for NEMS- ZnO nanorods based NEMS device: Gas sensor, future challenges.
Text Books / Reference Books
Course Objectives

• To provide fundamental concepts on intelligent manufacturing system (IMS) to achieve flexible, smart, and reconfigurable manufacturing processes.
• To familiarize various supporting technologies required to implement IMS.

Course Outcomes

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

CO1: Explain the various concepts of intelligent manufacturing systems.
CO2: Elaborate the various components features and its integration for IMS.
CO3: Choose suitable supporting technologies to enable IMS implementation.
CO4: Discuss the real time issues in implementations of IMS with suitable case studies.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus


Component of Intelligent Manufacturing Technologies, Development of Intelligent systems for Design, Process planning, Controls, Scheduling, Quality Management, Maintenance and Diagnostics.
Supporting technologies for IMS: Industry Internet of Things, Cyber Physical Systems, Cloud computing, RFID Technologies, Data Analytics, other Information and Communications Technology.

Framework for intelligent manufacturing: Smart design, Smart machines, Smart control, Smart scheduling, Human-Machine collaboration, collaborative robots and other enabling technologies such as AR and VR, Data-driven intelligent manufacturing models, Autonomous intelligent manufacturing units.

Applications and case studies in intelligent manufacturing systems implementation, limitation of technologies and other real time issues in implementations of IMS.
Text Books / Reference Books
Pre-requisite: Materials Science and Engineering (Knowledge Level)

Course Objectives
- To introduce composites and advanced materials and their applications
- To familiarize manufacturing, characterization of composite and aerospace alloys
- To provide knowledge about behaviour and applications of smart and nano-materials

Course Outcomes
At the end of the course, the student will be able to:
CO1: Interpret the properties and structure of composite and advanced material.
CO2: Identify the appropriate fabrication technique for a composite and aerospace alloys.
CO3: Examine the different behaviour of materials for aerospace applications.
CO4: Summarize the properties and applications of smart and nano-materials.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Aerospace Alloys: High strength Aluminium and Magnesium alloys, Nickel and Cobalt based Superalloys, Titanium alloys, their structures, structure-property relationships, heat treatment. Directional solidification and single crystal turbine blades. Case studies.

Unit 3
Smart Materials: Concept of shape memory, crystal structure, phase transformation mechanism and characteristics, properties, classification, applications. Nanomaterials: properties, classification, characterization, materials behaviour, fabrication and applications.

Text Books

Reference Books
Course Objectives
 To impart knowledge in the field of modern methods for simulation and modelling of production systems for industrial needs.
 To focus on technological processes and manufacturing systems and applies the principles of discrete simulation for their modeling using software tool.
 To familiarize with discrete event simulation for modelling & simulation of manufacturing systems.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Summarize the basic concepts and applications of discrete event simulation
CO2: Analyze the simulation input data
CO3: Verify and validate simulation models using statistical techniques
CO4: Analyze and interpret the simulation output results
CO5: Build credible simulation models for real-time applications

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3

Text Books

Reference Books
1998.
Course Objectives
- To familiarize the concept of sustainability manufacturing with tools and techniques.
- To inculcate knowledge on performing life cycle analysis.

Course Outcomes
At the end of the course, the student will be able to:
CO1: Describe the concepts of sustainable manufacturing.
CO2: Utilize tools and techniques of sustainable manufacturing.
CO4: Perform sustainability analysis using software packages.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PSO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Unit 1
Concept of sustainability, manufacturing operations, resources in manufacturing. Concept of triple bottom line, environmental, economic and social dimensions of sustainability. Relation between green, lean and sustainable manufacturing.

Unit 2

Unit 3
Life cycle analysis-Remanufacture and disposal, tools for LCA, optimization for achieving sustainability in manufacturing, value analysis, analysis for carbon footprint-software packages for sustainability analysis.

Text Books

Reference Books
Course Objectives:
- Learn the importance of systematic design process in product design
- Identify various steps involved in the design process
- Learn the importance of “function” and “form” in the design process
- Apply the systematic design process for product development

Course Outcomes
At the end of the course, the student will be able to:

CO1: Demonstrate the diverse methods employed in design process
CO2: Establish a workable design-thinking framework to solve critical problems
CO3: Analyze and map the user to whom the design solution is being offered
CO4: Interact with user to identify the customer needs
CO5: Be a more effective engineer, and communicate with high emotional and intellectual impact
CO6: Conceive, organize, lead and implement projects in interdisciplinary domain

CO/PO Mapping

<table>
<thead>
<tr>
<th>PO/PS O</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus
Overview of the Design Process – Philosophy of Traditional Design, Stages in product development, Reverse Engineering
Project mission statement, Stakeholder identification, Customer need identification process, Need analysis, Critical needs, Need metric matrix, Target Specifications.
Functional Design – Functional decomposition, Functional diagram, Product architecture, Identification of product modules,
Product Concept – Various methods of concept generation, Concept selection, TRIZ.

Text Books
Kevin Otto & Kristin Wood, Product Design, Pearson Education

Courses offered under the framework of
Amrita Values Programmes I and II
22AVP201 Message from Amma’s Life for the Modern World
Amma’s messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched
by Amma’s guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

22ADM211 Leadership from the Ramayana
Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

22ADM201 Strategic Lessons from the Mahabharata
Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

22AVP204 Lessons from the Upanishads
Introduction to the Upanishads: Sruti versus Smriti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

22AVP205 Message of the Bhagavad Gita

22AVP206 Life and Message of Swami Vivekananda
Brief Sketch of Swami Vivekananda’s Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji’s life.

22AVP207 Life and Teachings of Spiritual Masters India
Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

22AVP208 Insights into Indian Arts and Literature
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

22AVP209 Yoga and Meditation
The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali’s Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP210 Kerala Mural Art and Painting
Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

22AVP213 Traditional Fine Arts of India
India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is ‘Únity in Diversity’ and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

22AVP214 Principles of Worship in India
Indian mode of worship is unique among the world civilizations. Nowhere in the world has the philosophical
idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realization of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

22AVP215 Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirtyes, and demons of the theatrical world. Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and garga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

22AVP218 Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

22AVP219 Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

22AVP220 Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyam, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

22AVP221 Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala’s traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY

23CHY240 COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Get to understand the structure of molecules using symmetry.
CO2: Understanding Quantum mechanical approach to calculate the energy of a system.
CO3: Applying mathematical knowledge and quantum mechanical approach in finding out the characteristics-reactivity, stability, etc., of the molecule.
CO4: To get a brief idea about molecular mechanics based chemical calculations.CS5: To get an idea about general methodology of molecular modeling.

Syllabus

Unit 1
Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.


Unit 2
Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel’s MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel’s theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel’s coefficient matrix - Wheeland’s method - Hoffmann’s EHT method - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3
Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman’s theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes
Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction to molecular simulation - M.D. simulation.

TEXTBOOKS:

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
CO2: Learn the application of the electrochemical principles for the functioning and fabrication of industrial batteries and fuel cells
CO3: Acquire knowledge in solving numerical problems on applied electrochemistry
CO4: Analysis and practical problem solving in fabrication of batteries and fuel cells
CO5: Application of concepts and principle in industrial electrochemical processes
CO6: Evaluation of comprehensive knowledge through problem solving

Syllabus

Unit 1
Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler- Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2
Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel- metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroplating – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

TEXTBOOKS:

REFERENCES:

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

To provide the basic knowledge about fuels, rocket propellants and explosives.

Course Outcomes:

CO1: Understand the types of fuels and variation in their properties
CO2: Able to analyze the fuel content
CO3: Obtain knowledge in identifying a proper fuel as per the requirement
CO4: Ability to know the preparation and working of propellants and explosives

Syllabus

Unit 1

Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing -flow test, smoke points, storage and handling.


Unit 2

Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3


Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:


REFERENCES:


Evaluation Pattern
<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:
1. Understand the principles of green chemistry and its contribution to the development of sustainable products
2. Possess knowledge of the migration from a hydrocarbon-based economy to carbohydrate-based economy
3. Evaluate the deficiencies of traditional process and acknowledge the invent of new processes
4. Distinctly map the culmination of academic research to industrial chemistry

Course Outcomes:
CO1: Understand the evolving concept of Green Chemistry and its application to the manufacture of sustainable products
CO2: Appreciate the need for Renewable energy and Feed stock along with carbon sequestration through the fundamentals of Green Chemistry Techniques
CO3: Develop a coherence to evaluate systematic deficiencies in traditional Chemical science process and products
CO4: Undertake a purposeful Journey through the microscopic domain of academic research to the macroscopic domain of Industrial chemistry

Syllabus Unit
1
Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA. Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2
Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc. phase behaviour and solvent attributes of supercritical CO2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO2 fixation, green plastics, green oxidations, etc.

Unit 3
Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:
1. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

CO1: To develop an understanding of principle and working of the range of instrumental methods in analytical chemistry.

CO2: To provide an understanding and skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds.

CO3: To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in chemical analysis.

Syllabus

Unit 1


Separation Techniques: Brief outline of column, paper and thin layer chromatography - Ion exchange methods - principle and application – HPLC.

Unit 2

Gas chromatography - principle and applications – gel chromatography.


Unit 3


Thermal and Diffraction techniques: Principles and applications of DTG - DTA DSC - X-ray - Electron Diffraction Studies - SEM, TEM.

TEXTBOOKS:


REFERENCES:

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
**Course Objective:**
To provide sound knowledge on the application of electrochemistry in energy storage systems.

**Course Outcome**

| CO1 | Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics and fuel cells |
| CO2 | Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries |
| CO3 | Analysis of practical problem solving in fabricating batteries and fuel cells |
| CO4 | Evaluation of comprehensive knowledge through problem solving |

**Syllabus**

**Unit 1**
Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler- Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafelplots - exchange current density and transfer coefficients.

**Unit 2**
Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

**Unit 3**
Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.


**TEXTBOOKS:**

**REFERENCES:**

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Course Outcome:

CO1: Development of skill in identifying the nature and type of corrosion
CO2: Understanding the mechanism of various types of corrosion
CO3: Analysing the problem and find out a solution to combat corrosion in any sort of environment.

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
<th>PSO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

Syllabus  Unit


Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2

Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.


Unit 3

Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion.


TEXTBOOKS:


REFERENCES:

### Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
PHYSICS

23PHY240 ADVANCED CLASSICAL DYNAMICS L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Able to use the Lagrangian formalism to solve simple dynamical system
CO2: Able to understand Hamiltonian formalism and apply this in solving dynamical systems
CO3: Able to apply Lagrangian formalism in bound and scattered states with specific reference to Kepler’s laws and Scattering states
CO4: Able to solve problems in the Centre of Mass frame and connect it to Laboratory Frame of Reference
CO5: Understand and solve problems in rigid body rotations applying of Euler’s equations.

CO-PO Mapping

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to Lagrangian dynamics
Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2
Central field problem
Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics
Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3
Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.
Practical rigid body problems
Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite manoeuvring and attitude control - coning maneuver - Yo-yo despiner mechanism - gyroscopic attitude control, gravity- gradient stabilization.

TEXTBOOKS:

REFERENCE BOOKS:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes

CO1: To understand the nature of interaction between atoms in crystalline solid materials that determines their dielectric, magnetic and electrical properties.
CO2: Analyze the relation between the macroscopic dielectric constant and the atomic structure of an insulator.
CO3: Fundamental concepts of magnetic fields required to illustrate the magnetic dipoles. This forms the basis to understand the magnetic properties of dia, para, ferro, antiferro and ferri magnetic materials.
CO4: Fundamentals concerned with conduction mechanism in metals and superconductors.
CO5: Understand the basics for classification of materials based on its conductivity, nature of chemical bonds in Si and Ge, carrier density, energy band structure and conduction mechanism in intrinsic and extrinsic semiconductors.

CO-PO Mapping

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

Syllabus Unit

Unit 1
Conducting materials: The nature of chemical bond, crystal structure Ohm’s law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and its consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2
Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and its applications.

Unit 3
Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of
the p-n junction rectifier, the n-p-n transistor.

**TEXTBOOK:**

**REFERENCES:**

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Unit 1

Review of some basic concepts and principle of laser.


Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of FWHM natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening. Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS


Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields:


REFERENCES:


**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes

CO1: Understand, Comprehend and acquaint with concepts of NanoPhysics
CO2: To familiarize the material’s property changes with respect to the dimensional confinements.
CO3: Acquire knowledge on the modern preparation process and analysis involved in the nanomaterial’s research
CO4: To learn about the technological advancements of the nano-structural materials and devices in the engineering applications

CO-PO Mapping

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Syllabus Unit 1

Introduction

Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials - classification of fabrication methods – top down and bottom up methods.

Concept of quantum confinement and phonon confinement


Unit 2

Tools for characterization:


Nanoscale materials – properties and applications:

Carbon nanostructures – structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes

Unit 3

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) – fabrication (lithography) and applications. Nanodevices - resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications.

**TEXTBOOKS:**


**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

CO1: Understand, comprehend and acquaint with the basics working principles and governing equations of electronic devices like diodes, Bipolar junction transistors, Mosfet and heterojunction transistors
CO2: Analyze and Solve physics problems pertaining to various process like charge conduction across semiconductor device.
CO3: Apply the knowledge for the development and design of new methods to determine semiconductor parameters and devices

Syllabus

Unit 1
Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects


Unit 2


Theory of p-n junctions – diode and transistor:p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, junction capacitance and voltage breakdown.

Unit 3


Modern semiconducting devices: CCD - introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

REFERENCES:
**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
23PHY245  ASTROPHYSICS  L-T-P-C: 3-0-0-3

Course Outcomes:

After completion of the course students should be able to

CO1: Get a broad knowledge of scientific and technical methods in astronomy and astrophysics.

CO2: Apply mathematical methods to solve problems in astrophysics.

CO3: Develop critical/logical thinking, scientific reasoning and skills in the area of modern astrophysics.

CO-PO Mapping:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1


Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris. Celestial mechanics - Kepler’s laws - and derivations from Newton’s laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2


Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds - Nebulae.

Unit 3

Galactic astronomy: Distance measurement - red shifts and Hubble’s law – age of the universe, galaxies – morphology - Hubble’s classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.


Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - planklength and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

REFERENCES:

Publishing Company, 1996
5. ‘Stellar Astronomy’ by K. D. Abhayankar.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1

Unit 2

Unit 3
Regression: Introduction, Least Squares Estimators of the Regression Parameters, Distribution of the Estimators, Statistical Inferences about the Regression Parameters, the Coefficient of Determination and the Sample Correlation Coefficient, Analysis of Residuals, transforming to Linearity, Weighted Least Squares, Polynomial Regression, Multiple Linear Regression, Predicting Future Responses, Logistic Regression Models for Binary Output Data.

TEXTBOOK:


REFERENCES:


Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Elements of Game theory, examples, Strategic Games, 2 Player Strategy Games, payoffs, Minimax, Weak and Strong Domination, Saddle Points, Nash Equilibrium, Prisoner’s Dilemma, Stag Hunt, Matching pennies, BOS, Multi NE, Cooperative and Competitive Games, Strict and Non Strict NE, Best response functions for NE.

Unit 2
Combinatorial games, Winning and losing positions, Subtraction Game, 3-Pile and K-Pile Games, Proof of Correctness, Variations of K-Pile Games, Graph Games, Construction, Proof of finiteness, SG theorem for sum of games.

Unit 3
Cournot’s Oligopoly, Bertrand’s Oligopoly, Electoral Competition, Median Voter Theorem, Auctions, role of knowledge, Decision making and Utility Theory, Mixed Strategy Equilibrium, Extensive Games with Perfect Information, Stackelberg’s model of Duopoly, Buying Votes, Committee Decision making, Repeated Gmes, Prisoner’s Dilemma, Supermodular Game and Potential games

TEXTBOOK:
1. Martin Osborne, An Introduction to Game Theory, Oxford University Press.

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
23MAT242  NUMERICAL METHODS AND OPTIMIZATION  L-T-P-C: 3-0-0-3

Syllabus

09 (a) Roots finding methods:
Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

09 (b) Interpolations:
Interpolation and Approximation: Lagrange, Newton’s Divided Difference, Newton’s Forward and Backward interpolations.

07 (b) Multivariable optimization (2 Credits)

TEXTBOOK:

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM COMMON TO ALL PROGRAMS

| 23MNG331 | FINANCIAL MANAGEMENT | L-T-P-C: 3-0-3 |

Course Objectives
- Understand the overview of financial management
- Inculcate methods and concepts on valuation
- Familiarize with working capital management, financial analysis and planning

Course Outcomes
- CO1: Understand and apply time value concept of money and use this for investment criteria decisions.
- CO2: Evaluate the risk and return for various alternatives of investment.
- CO3: Apply the capital budgeting techniques and evaluate the investment decisions.
- CO4: Understand working capital management, cash and liquidity management and financial statements. CO/PO

Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3


Mergers and Takeovers - International trade.

TEXT BOOKS
REFERENCE BOOKS

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- Understand the complexity and key issues in supply chain management.
- Describe logistics networks, distribution planning, routing design and scheduling models.
- Familiarize dynamics of supply chain and the role of information in supply chain.
- Understand the issues related to strategic alliances, global supply chain management, procurement and outsourcing strategies.

Course Outcomes

CO1: Analyze the complexity and key issues in supply chain management
CO2: Evaluate single and multiple facility location problems, logistics network configuration, vehicle routing and scheduling models
CO3: Analyze inventory management models and dynamics of the supply chain
CO4: Develop the appropriate supply chain through distribution requirement planning and strategic alliances
CO5: Identify the issues in global supply chain management, procurement and outsourcing strategies

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction: Introduction to SCM-the complexity and key issues in SCM – Location strategy – facility location decisions – single facility and multiple location models.

Unit 2
Inventory: Inventory Management and risk pooling-managing inventory in the SC. Value of Information-bullwhip effect- lead time reduction.

Unit 3

TEXT BOOK
REFERENCE BOOKS


Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objective

To educate the students to apply concepts and techniques in marketing so that they become acquainted with the duties of a marketing manager with an emphasis to make the students exposed to the development, evaluation, and implementation of marketing management in a variety of business environments.

Course Outcomes

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

CO1: Illustrate key marketing concepts, theories and techniques for analysing a variety of marketing situations
CO2: Identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken and appreciate the implication for marketing strategy determination and implementation
CO3: Develop the ability to carry out a research project that explores marketing planning and strategies for a specific marketing situation
CO4: Understand the need and importance of sales promotions and make use of advertising
CO5: Manage a new product development process from concept to commercialization.
CO6: Illustrate the importance of modern trends in retailing and marketing logistics

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus Unit

UNIT 1
Marketing Process: Definition, Marketing process, dynamics, needs, wants and demands, value and satisfaction, marketing concepts, environment, mix. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

Buying Behaviour and Market Segmentation: Major factors influencing buying behaviour, buying decision process, businessbuyingbehaviour. Segmenting consumer and business markets, market targeting.

UNIT 2
Product Pricing and Marketing Research: Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT 3
Developing New Products - Challenges in new-product Development - Effective organizational arrangements - Managing the development Process: ideas - Concept to strategy - Development to commercialization – The consumer- adoption process. Advertising Sales Promotion and Distribution: Characteristics, impact, goals, types, and sales promotions- point of
purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

TEXT BOOKS

REFERENCE BOOKS

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- To discuss the project life cycle and build a successful project from pre-implementation to completion.
- To introduce different project management tools and techniques

Course Outcomes

CO1: Appraise the selection and initiation of individual projects and its portfolios in an enterprise.
CO2: Analyze the project planning activities that will predict project costs, time schedule, and quality.
CO3: Develop processes for successful resource allocation, communication, and risk management.
CO4: Evaluate effective project execution and control techniques that results in successful project completion

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1


Unit 2

**Project Presentation:** WBS, Project Network – Activity on Arrow (A-O-A), Activity on Node (A-O-N). **Project Scheduling:** Gant Chart, Critical Path Method (CPM), Project Evaluation & Review Technique (PERT).(6hrs) Linear time cost trade-offs in project - Direct cost, indirect cost, Project crashingResource Consideration - Profiling, Allocation, Levelling.

**Introduction to project management software:** Primavera/ Microsoft project

Unit 3

**Project Execution:** Monitoring control cycle, Earned Value Analysis (EVA), Project Control – Physical control, Human control, financial control.

**Organizational and Behavioral Issues:** Organizational Structure, Selection-Project Manager, Leadership Motivation, Communication, Risk Management.

**Project Termination:** Extinction, Addition, Integration, Starvation.

TEXT BOOKS

REFERENCE BOOKS

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- To impart knowledge on the fundamentals of costing, pricing methods and strategies.
- To give an overview of production operations planning.
- To summarize various quantitative methods of plant location, layout and lean manufacturing.
- To familiarize the concepts of e-commerce, e-purchasing, MRP and ERP in business.

Course Outcomes

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

CO1: Understand the concepts of cost and pricing of goods and appraise project proposals
CO2: Design and analyze manufacturing and service processes and to measure the work performed.
CO3: Understand and analyze the key issues of supply chain Management
CO4: Understand the application of lean manufacturing tools and six sigma concepts
CO5: Select appropriate plant location and their layout methods
CO6: Create capacity plan, aggregate plan, schedule, ERP & MRP systems

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus Unit


Unit 2


Unit 3


TEXT BOOKS

REFERENCE BOOKS

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports.
Course Objectives

Familiarizing the students with quantitative tools and techniques, which are frequently applied in operational decisions

Course Outcomes

CO1: Formulate operations research models to optimize resources.
CO2: Solve transportation and assignment problems using suitable techniques.
CO3: Apply appropriate technique to analyze a project with an objective to optimize resources.
CO4: Solve operational problems using decision theory approaches.
CO5: Select suitable inventory model for effective utilisation of resources.
CO6: Solve Operations Research problems using software package

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Linear Programming: Formulations - graphical solutions - Simplex Method - Duality, Dual simplex method.
Transportation model: Assignment model – Travelling Salesman Problem.

Unit 2

Unit 3
Sequencing model – 2 machines ‘n’ jobs, ‘m’ machines ‘n’ jobs – n jobs 2 machines.
Simulation –Monte Carlo simulation: simple problems

Lab session: Practicing case problems with excel solver/MatLab/LINGO package

TEXT BOOK

REFERENCE BOOKS
Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (Theory) (CAT)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (Lab) (CAL)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>35</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- To inculcate the concepts of work study and its application to industrial practice
- Impart skills to design, develop, implement, and improve manufacturing/service systems

Course Outcomes

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

CO1: Create value to organizations through the analysis, evaluation, and improvement of work systems using work study and method study

CO2: Develop work systems through motion economy principles

CO3: Apply work measurement techniques to improve productivity, fix wages and incentives

CO4: Apply systematic layout planning techniques and work station design principles based on ergonomics and material handling.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Work System: Elements of work, maintenance of machines, interaction, effect of working conditions and environment, physical and mental fatigue.

Productivity: Productivity, factors affecting production, Measurement of productivity.

Work Study: Definition and scope of work study; Areas of application of work study in industry; Human aspects of work study.

Method Study: Information collection, recording techniques, and processing aids; critical examination; development, installation and maintenance of improved methods.

Unit 2

Motion Economy and Analysis: Principles of motion economy; Motion analysis; Micromotion and Memomotion study; Therbligs and SIMO charts; Normal work area and design of work places; Basic parameters and principles of work design.

Work Measurement: Work measurement techniques; Calculation of standard time, work sampling and predetermined Motion time systems.

Wages and Incentive Schemes: Introduction, wage payment of direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour

Unit 3

Plant Layout: Concept of plant layout, types of layout; factors affecting plant layout.

Ergonomics: Ergonomic Design of equipment and work place. work station design, factors considered in designing a work station, ergonomic design standards - Study of development of stress in human body and their consequences. Case Studies. Production planning and scheduling.

Material Handling: Introduction and functions of material handling equipment, selection of material handling equipment for different requirements, safety requirements.
Recent advances in Industrial Engineering.

TEXT BOOKS

REFERENCE BOOKS

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continues Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objective
To impart the knowledge of basic statistical tools for analysis and interpretation of qualitative and quantititative data for decision making.

Course Outcomes

CO1: Apply basic probability and statistics concepts for various business problems
CO2: Perform test of hypothesis
CO3: Compute and interpret the result of regression and correlation analysis for forecasting
CO4: Solve real time problems by applying different decision making methods.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus Unit

Unit 1
Quantitative methods: Basic terminology in probability, probability rules, conditions of statistical dependence and independence, Bayes Theorem, Discrete Random Variables review of probability distributions, measure of central tendency.
Sampling and sampling distributions: Introduction to sampling, random sampling, design of experiments, introduction to sampling distributions
Estimation: point estimates, interval estimates and confidence intervals, calculating interval estimates of mean from large samples, using t test, sample size estimation.

Unit 2
Testing hypothesis: Introduction, basic concepts, testing hypothesis, testing when population standard deviation is known and not known, two sample tests.
Chi-square and analysis of variance: introduction, goodness of fit, analysis of variance, inferences about a population variation

Unit 3
Regression and correlation: Estimation using regression line, correlation analysis, finding multiple regression equation, modelling techniques,
Non parametric methods and time series and forecasting: Sign test for paired data, rank sum test, rank correlation, Kolmogrov – smirnov test, variations in time series, trend analysis, cyclic variation, seasonal variation and irregular variation. Decision theory: Decision tree analysis

TEXT BOOKS

REFERENCE BOOKS
1. Bain.L. J. and Engelhardt M. - 'Introduction to Probability and Mathematical Statistics' - Duxbury Press -
March 2000 - 2nd Edition


Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objective
To impart knowledge on quality management principles, tools, techniques and quality standards for real life applications.

Course Outcomes

CO1: Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.

CO2: Evaluate the performance measures using various quality and management tools.

CO3: Apply the Quality Function Deployment, Taguchi principles, Total Productive Maintenance and Failure Mode and Effect Analysis concepts to solve industrial problems.

CO4: Practice the various quality system in industry.

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus Unit


Unit 2
Customer satisfaction – Customer retention - Employee involvement - Performance appraisal - Continuous process improvement - Supplier partnership - Performance measures. Seven tools of quality. Statistical fundamentals - Control Charts for variables and attributes - Process capability - Concept of six sigma - New seven management tools - Benchmarking.

Unit 3

TEXT BOOK

REFERENCE BOOKS
**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports*
Course Objectives

- Understand Lean manufacturing principles and tools
- Inculcate the concepts of value stream mapping
- Familiarize lean implementation practices

Course Outcomes

CO1: Identify key requirements and concepts in lean manufacturing.
CO2: Initiate a continuous improvement change program in a manufacturing organization
CO3: Analyze and improve a manufacturing system by applying lean manufacturing tools
CO4: Build value stream map for improving the productivity
CO5: Improve productivity through lean practices

CO/PO Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1


Unit 2

Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map – Building a Current State Map (principles, concepts, loops, and methodology) – Application to the factory Simulation scenario.

Unit 3

Value Stream Mapping – Future State: Key issues in building the Future State Map – Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop – Example of completed Future State Maps – Application to factory simulation


TEXT BOOKS


REFERENCES BOOKS

2. Rother, M. and Shook, J., 'Learning to see', The Lean Enterprise Institute, Brookline, USA, 2003.
**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignments, Projects, and Reports*
Course Objectives

- This course describes the key aspects of a software project.
- It introduces the basic principles of Engineering Software Projects. Most, if not all, students’ complete projects as part of assignments in various courses undertaken. These projects range in size, subject and complexity but there are basic project essentials that need to be understood and practiced for successful team project outcomes.
- The course provides an understanding of the purpose, methods and benefits of process management by exposing the student to the concepts, practices, processes, tools and techniques used in process management for software development.

Course Outcomes

CO 1: To understand the basic concepts, terminologies and issues of software project management.
CO 2: To apply appropriate methods and models for the development of solutions.
CO 3: To analyze the cost-benefits of calculations so as to optimize the selection strategy
CO 4: To evaluate methods, models and technologies towards achieving project success
CO 5: To design and evaluate network planning models with criticality

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit

1 Introduction to Software Project Management- Software Projects - ways of categorizing software projects – problems with software projects - Project Life Cycle- Management -Setting objectives –Stakeholders - Project Team- Step-wise
 : An overview of project planning -project Evaluation –Selection Of Appropriate Project Objectives- Software Effort Estimation Techniques, Function Point Analysis-Object Point-COCOMO.

Unit 2
Activity planning-- project schedules - sequencing and scheduling projects - Network planning model – AON andAOA-identifying critical activities-Crashing And Fast Tracking-.Risk management—Categories , Risk planning, Management and Control - Evaluating risks to the schedule. PERT- Resource Allocation, Monitoring and Tracking -Monitoring and control - allocation - identifying resource requirements - scheduling resources - creating critical paths
- publishing schedule - cost schedules- sequence schedule.

Unit 3
Monitoring and control – Visualizing Progress, Earned value analysis, managing people and organizing teams-organizational structures- Planning for small projects. Case Study: PMBOK , Agile Development

TEXT BOOK(S)

REFERENCE(S)

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Pre-Requisite(s): 19MAT112 Linear Algebra, 19MAT205 Probability and Random Processes

Course Objectives

- This course serves as an introduction to financial engineering including cash flows, financial decision making etc.
- It gives a thorough yet highly accessible mathematical coverage of standard and recent topics of introductory investments: fixed-income securities, modern portfolio theory, optimal portfolio growth and valuation of multi-period risky investments.

Course Outcomes

CO1: Apply basic concepts to understand and evaluate cash flows
CO2: Evaluate and arrive at a financial investment decision employing the underlying knowledge of stocks and derivatives
CO3: Analyse and design Portfolio selection methods
CO4: Understand capital market theory for stock performance evaluation

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3

TEXT BOOK(S)
REFERENCE(S)

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives

- Prepare engineering students to analyze and understand the business, impact of economic environment on business decisions

Course Outcomes

CO1: Understand and evaluate the economic theories, cost concepts and pricing policies and draw inferences for the investment decisions for appraisal and profitability

CO2: Appraise the dynamics of the market and market structures and portray implication for profit and revenue maximization

CO3: Employ operations research and allied techniques in managerial economics for an enhanced analysis and decision making

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2

Unit 3

TEXT BOOK(S)

REFERENCE(S)
### Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Course Objectives

- This course is to expose the students to the managerial issues relating to information systems and also understand the role of Business Process Reengineering technique in an organization.
- The course also focus on the management of information technology to provide efficiency and effectiveness or strategy decision making.

Course Outcomes

CO1: Understand the fundamental concepts of Information Systems in business.
CO2: Understand and analyse the strategic role played by Information Systems in e-commerce.
CO3: Analyse management challenges in Global Businesses predominantly dependent on IS functions.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus Unit

Unit 1

Unit 2

Unit 3

TEXT BOOK(S)

REFERENCE(S)
Laudon K, Laudon JP. Management Information Systems; 2010

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS
COMMON TO ALL PROGRAMS

23CUL230  ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE    L-T-P-C: 2-0-0-2

Course Objectives:

The course offers to explore the seminal thoughts that influenced the Indian Mind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.

Syllabus

Unit 1
Goals of Life – Purusharthas
What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life & Professional life; Followed by a Goal setting workshop;
Yogic way of Achieving Life Goals – (Stress Free & Focused Life)
Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop); Experiencing life through its Various Stages
Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2
Personality Development
What is Personality – Five Dimensions – Pancha Kosas (Physical / Energy / Mental / Intellectual / Bliss); Stress Management & Personality; Self Control & personality; Fundamental Indian Values & Personality;
Learning Skills (Teachings of Amma)
Art of Relaxed Learning; Art of Listening; Developing ‘Shraddha’ – a basic qualification for obtaining Knowledge; Communication Skills - An Indian Perspective;

Unit 3
Developing Positive Attitude & Friendliness - (Vedic Perspective);
Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);
Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:

1. Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9
2. Complete works of Swami Vivekananda (Volumes 1 to 9)
3. Mahabharata by M. N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)
4. Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Vols. 1 to 3)
7. Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay
10. Yoga In Daily Life - Swami Sivananda – published by Divine Life Society
12. All about Hinduism – Swami Sivananda - Published by Divine Life Society
15. Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi

17. *Mind Sound Resonance Technique (MSRT)* Published by Swami Vivekananda Yoga Prakashana, Bangalore.

18. *Yoga & Memory* - Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.

### Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Syllabus

Unit 1
1. The anatomy of ‘Excellence’. What is ‘excellence’? Is it judged by external factors like wealth?
2. The Great Flaw. The subject-object relationship between individual and world. Promote subject enhance excellence.
3. To work towards excellence, one must know where he is. Our present state... An introspective analysis. Our faculties within.

Unit 2
4. The play of the mind. Emotions – convert weakness into strength.
5. The indispensible role of the intellect. How to achieve and apply clear thinking?
7. Increase Productivity, reduce stress. work patterning.

Unit 3
8. The art of right contact with the world. assessment, expectations.
9. Myths and Realities on key issues like richness, wisdom, spirituality.
10. Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:
The Bhaja Govindam and the Bhagavad Gita.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

This course offers a journey of exploration through the early developments in India of astronomy, mathematics, technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as actual techniques.

Syllabus

Unit 1
1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. Vedanga Jyotisha and the first Indian calendars;
5. Shulba Sutras and the foundations of Indian geometry;

Unit 2
1. Astronomy & mathematics in Jain and Buddhist literature;
2. The transition to the Siddhantic period; Aryabhata and his time;
3. The Aryabhatiya: concepts, content, commentaries;
4. Brahmagupta and his advances;
5. Other great Siddhantic savants;
6. Bhaskara II and his advances;

Unit 3
1. The Kerala school of mathematics;
2. The Kerala school of astronomy;
3. Did Indian science die out?;
4. Overview of recent Indian scientists, from S. Ramanujan onward;
5. Conclusion: assessment and discussion;

TEXTBOOK:
Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao

REFERENCE:
IFIH’s interactive multimedia DVD on Science & Technology in Ancient India.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
This course offers the foundation necessary to understand Eastern approaches to psychology and spirituality. The course includes experiential components centering on meditation and spiritual practice.

Syllabus

**Unit 1**
Introduction
A short history of Modern Psychology - Major Schools of Modern Psychology - The three major forces in Western Psychology - Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology
What is Yoga? - Rise of Yoga Psychology tradition - Various schools of Yoga Psychology - Universal Goal of all Yoga-schools.

Patanjali Yoga Sutra – 1

Patanjali Yoga Sutra – 2

**Unit 2**

Patanjali Yoga Sutra – 3
Two formulae - Necessity of Abhyasah and Vairagiyah - Foundation of Abhyasah - Foundation of Vairagiyah.

Patanjali Yoga Sutra – 4

Patanjali Yoga Sutra – 5
Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.

Patanjali Yoga Sutra – 6

Patanjali Yoga Sutra – 7

**Unit 3**

Patanjali Yoga Sutra – 8

Patanjali Yoga Sutra – 9
Patanjali Yoga Sutra – 10
Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses.

REFERENCES:
1. The course book will be “The four chapters of Freedom” written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.
3. Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttarajal.
4. ‘Hatha Yoga Pradipika’ Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To introduce business vocabulary; to introduce business style in writing and speaking; to expose students to the cross-cultural aspects in a globalised world; to introduce the students to the art of persuasion and negotiation in business contexts.

Course Outcomes

CO1: Familiarize and use appropriate business vocabulary and etiquettes in verbal communication in the professional context
CO2: Understand organizational structures, pay structures and performance assessments
CO3: Apply language skills in drafting various business documents and other necessary communications in the business context
CO4: Understand and address cross cultural differences in the corporate environment
CO5: Participate in planned and extempore enactments of various business situations

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Unit 2
Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – Speaking: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings.

Unit 3
Active Listening: Pronunciation – information gathering and reporting - Speaking: Cross-Cultural Issues, Group Dynamics, negotiation & persuasion techniques.

Activities
Case studies & role-plays.

BOOKS RECOMMENDED:


**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To expose the students to the greatness of Indian Thought in English; to develop a sense of appreciation for the lofty Indian Thought; to develop an understanding of the eclectic Indian psyche; to develop an understanding about the societal changes in the recent past.

Syllabus
Unit 1
Poems
Rabindranath Tagore’s Gitanjali (1-10); Nizzim Ezekiel’s Enterprise; A.K. Ramanujam’s Small-Scale Reflections on a Great House.

Unit 2
Prose
Khushwant Singh’s The Portrait of a Lady; Jhumpa Lahiri’s Short Story - Interpreter of Maladies.

Unit 3
Drama and Speech
Vijay Tendulkar’s Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru/ S. Radhakrishnan / A. P. J. Abdul Kalam’s My Vision for India etc. (any speech).

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To expose the students to different genres of Literature; to hone reading skills; to provide deeper critical and literary insights; to enhance creative thinking; to promote aesthetic sense.

Syllabus

Unit 1

Poems

Unit 2

Short Stories

Unit 3

Prose

Practicals:

Role plays: The Proposal, Chekov / Remember Caesar, Gordon Daviot / Final Solutions, Mahesh Dattani, Bookreviews, Movie reviews.

SUGGESTED READING:
The Old Man and the Sea, Hemingway / Any one of the novels of R.K. Narayan, etc.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To introduce the students to the elements of technical style; to introduce the basic elements of formal correspondence; to introduce technical paper writing skills and methods of documentation; to improve oral presentation skills in formal contexts.

Course Outcomes:
After the completion of the course the student will be able to:

CO1: Understand and use the basic elements of formal correspondence and methods of documentation
CO2: Learn to edit technical content for grammatical accuracy and appropriate tone and style
CO3: Use the library and internet recourses for research purposes
CO4: Demonstrate the ability to communicate effectively through group mock-technical presentations and other activities

Mapping of course outcomes with program outcomes:

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus:

Unit 1

Unit 2
Different kinds of written documents: Definitions – descriptions – instructions – recommendations - manuals -reports – proposals; Formal Correspondence: Letter Writing including job applications with Resume.

Unit 3

Practice in oral communication and Technical presentations

REFERENCES:
**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To help the students learn the fine art of story writing; to help them learn the techniques of story telling; to help them study fiction relating it to the socio-cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianness.

Syllabus
Unit 1

Unit 2

Unit 3
Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

TEXT:

REFERENCE:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Population - Identity
How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions; Grammar – Pronouns - subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2
The suburbs - At the train station
Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city (church, town hall, post office…)
Grammar – Pronouns - subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3
Paris and the districts - Looking for a room
Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.
Grammar - Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:
Metro St Michel - Publisher: CLE international

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1

The first room of a student
A party to celebrate the 1st room; Description of a room; furniture; Locate objects: prepositions (devant, derrière, dans…), Read advertisement; Appreciation (I like, I prefer,).

Grammar - Perfect past tense with avoir; Possessive adjectives (mon, ton, son…); Demonstrative adjectives (ce, cet, cette); Yes (oui, si).

Unit 2 Small jobs
Conversation on the phone; Give Time indications; Answer a job offer; Describe a job; Suggest a meeting time.
Grammar - Perfect past tense with être and avoir (continuation); Possessive adjectives (notre, votre, leur); Prepositions (à, pour, avec …); Pronoun as direct object (le, la, l’, les).

Unit 3

University Restaurant
Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choose a menu or diet, Expression of quantities (beaucoup, peu).

Grammar - Partitif (expressing quantity) (du, de la, pas de…); Comparison (plus…que, moins…que, autant …que); Interrogation (continuation), inversion, Est-ce que, qu’est-ce que?.

TEXTBOOK:
Metro St Michel - Publisher: CLE International

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Greetings: Introducing one-self (formal and informal context), saying their name, origin, living place, occupation. Numbers 1-100: Saying the telephone number. Countries and Languages.
Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.
Vocabulary: Professions.

Unit 2
Giving the personal details. Name, age, marital status, year of birth, place of birth, etc. Numbers till 1000. Saying a year. Alphabets – spelling a word.
Filling up an application form; In the restaurant – making an order.
Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article Vocabulary: Food items.

Unit 3

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Shopping and orientation in supermarket; Conversation between the customer and salesman; Where one finds what in supermarket; Asking for requests and suggestions.

Grammar: Dative of personal pronouns. Imperative form. Vocabulary: Consumables and measurements;

Unit 2
Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing upon appointment.

Grammar: Model verbs; Prepositions with time and place; Ordinal numbers. Vocabulary: Leisure activities, weekdays, months and seasons.

Unit 3
Family and household; Family and relations; household and daily routine. Grammar: Possessive articles; Divisible and indivisible verbs.
Vocabulary: Family circle; Household articles.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

To have an elementary exposure to German language; specifically

1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.

(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.) Some useful websites will be given.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative. Some German culture. Films.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To teach Hindi for effective communication in different spheres of life - Social context, Education, governance, Media, Business, Profession and Mass communication.

Course Outcomes:
After the completion of the course the student will be able to:

CO1: Gain knowledge about the nature and culture of Hindi language
CO2: Understand the structural aspects of Hindi language
CO3: Apply the knowledge of the grammatical structures to communicate in Hindi
CO4: Analyse the social significance of modern literature.
CO5: Develop the ability to translate a given text to Hindi

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Introduction to Hindi Language, National Language, Official Language, link Language etc. Introduction to Hindi language, Devanagari script and Hindi alphabet.


Unit 2
Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb indifferent tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender& number - General vocabulary for conversations in given context –understanding proper pronunciation - Conversations, Interviews, Short speeches.

Unit 3
Poems – Kabir 1st 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit 4

Unit 5
Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Juloos.
BOOKS:

1. Prem Chand Ki Srvastha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi
2. Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radhakrishna publishing House, New Delhi

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as anthology.

Course Outcomes:

After the completion of the course the student will be able to:

CO1: Understand the grammatical structures of Hindi
CO2: Understand the post modern trends of literature
CO3: Enhance critical thinking and writing skills
CO4: Identify and analyse different literary and audio-visual material
CO5: Apply fundamental knowledge of Hindi in formal and informal writing

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus:

Unit 1
Kavya Tarang; Dhumil ke Anthim Kavitha [Poet-Dhumil]; Dhabba [Poet-Kedarnath Singh]; Proxy [Poet-Venugopal]; Vakh [Poet-Arun Kamal]; Maachis [Poet-Suneeta Jain].

Unit 2
Communicative Hindi - Moukhik Abhivyakthi

Unit 3
Audio-Visual Media in Hindi – Movies like Tare Zameen par, Paa, Black etc., appreciation and evaluation. Newsreading and presentations in Radio and TV channels in Hindi.

Unit 4
Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5

BOOKS:
2. *Gadya Manjusha: Editor: Govind, Jawahar Pusthakalay, Mathura*

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Syllabus

Unit 1
Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Unit 3
Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost–savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introduction
General Introduction; ‘His + Story’ or ‘History’ ?; The concepts of ‘nation’, ‘national identity’ and ‘nationalism’; Texts and Textualities: Comparative Perspectives.

Unit 2
Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3
Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao; V.S. Naipaul.

Conclusion

REFERENCES:
1. Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.
2. Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introduction
A peep into India’s glorious past
Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramaraiya – Yudhisthira’s ramarajya; Sarasvati - Sindhra Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmnya Dharma and the rise of Jainism and Buddhism – the sixteen Mahajanapadas and the beginning of Magadhan paramountcy - Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classicalsanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indiansupremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2
India’s contribution to the world: spirituality, philosophy and sciences
Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization
What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Unit 3
Women in Indian society
The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya’s Arthasastra and Mrichchhakatikamof Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India
The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore; Understanding Mahatma Gandhi; A new nation is born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today; Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion
The Wonder that was India; The ‘politics’ and ‘purpose’ of studying India.

REFERENCES:
17. Aurobindo, Sri. The Indian Renaissance / India’s Rebirth / On Nationalism.
25. Danino, Michel. The Invasion That Never Was.
34. Dharampal. Archival Compilations (unpublished)

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Syllabus

Unit 1
Introduction
General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.
Ancient India – up to 600 B.C.
Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King(Sri Rama) and the ideal state (Ramaraja) – Yudhisthira’s ramaraja; Sarasvati - Sindhu civilization and India's trade links with other ancient civilizations; Towards chieftoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Ind–Gangetic plain.

Unit 2
Classical India: 600B.C. – 1200 A.D.
The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya’s Arthasastra; of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India’s maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas

Medieval India: 1200 A.D. – 1720 A.D.
Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3
Modern India: 1720 - 1947
the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was ‘traditional’ or ‘Indian’) – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern bankingsystem; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry: the Tatas and the Birlas; Modern India: the growth of large-scale industry – irrigation and railways – money and credit – foreign trade; Towards partition – birth of two new nations – division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947
India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new/emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.

Conclusion

REFERENCES:

### Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introduction to Health
Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits - eating disorders, skipping breakfast, junk food consumption.

Practicals - Therapeutic Diets

Unit 2
Food and Nutritional Requirements during Adolescence
Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction etc

Practicals - Ethnic Foods

Unit 3
Need for a Positive Life Style Change
Peer pressure & procrastination, Stress, depression, suicidal tendency, Mini project review and viva, Whole portions revision.

Practical - Cooking without Fire or Wire-healthy Snacks

TEXTBOOKS:

REFERENCE BOOKS:
2. WHO Report on Adolescent Health: 2010

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads.

Unit 2
The relevance of these classics in a modern age.

Unit 3
Goals of human life - existential problems and their solutions in the light of these classics etc.

REFERENCE:
The Bhagavad Gita, Commentary by Swami Chinmayananda

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
23HUM236  INTRODUCTION TO INDIA STUDIES  L-T-P-C: 2-0-0-2

PREAMBLE:

This paper will introduce the students to the multiple dimensions of the contribution of India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.

Syllabus

Unit 1
A brief outline of Indian history from prehistoric times to the present times.

Contributions of India to world culture and civilization: Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.

Unit 2
Modern India: Challenges and Possibilities.

Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today - unemployment – corruption – degradation of cultural and moral values - creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.

Unit 3
Modern Indian Writing in English: Trends in Contemporary Indian Literature in English.

TEXTBOOK:

Material given by the Faculty

BACKGROUND LITERATURE:

1. Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.
2. Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.
3. Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.
4. Outlines of Indian Philosophy, M. Hiriyanan, MLBD.
5. An Advanced History of India, R. C. Majumdar et al, Macmillan.
6. India Since 1526, V. D. Mahajan, S. Chand & Company
7. The Indian Renaissance, Sri Aurobindo.
8. India’s Rebirth, Sri Aurobindo.
13. Awaken Children: Conversations with Mata Amritanandamayi
15. Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.
16. Web of Indian Thought, Sister Nivedita
17. Essays on Indian Nationalism, Anand Kumaraswamy
18. Comparative Aesthetics, Volume 2, Kantil Chandra Pandey, Chowkhamba, Varanasi
19. The Invasion That Never Was, Michel Danino
21. Hayavadana, Girish Karnard, OUP.
22. *Naga-Mandala, Girish Karnard, OUP.*

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.*
OBJECTIVES:

To familiarize students with Sanskrit language; to introduce students to various knowledge traditions in Sanskrit; to help students appreciate and imbibe India’s ancient culture and values.

Syllabus

Unit 1

Unit 2
Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3

Unit 4

Unit 5
Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:

1. Vakya Vyavahara - Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi
2. The Wonder that is Sanskrit - Dr. Sampadananda Mishra, New Delhi

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><em>Continuous Assessment (CA)</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Yup 1
Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.
NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village/slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

Unit 2
Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3
Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.
Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style

Unit 4
Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.

Unit 5
Environmental Issues: Environment conservation, enrichment and sustainability, climate change, waste management, rain water harvesting, energy conservation, waste land development.

Project Work / Practical

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives

1. To help students acquire the basic knowledge of behavior and effective living
2. To create an awareness of the hazards of health compromising behaviours
3. To develop and strengthen the tools required to handle the adversities of life

Course Outcome

CO 1: Understand the basic concepts of Behavioral Psychology
CO 2: Demonstrate self reflective skills through activities
CO 3: Apply the knowledge of psychology to relieve stress
CO 4: Analyse the adverse effects of health compromising behaviours.
CO 5: Evaluate and use guided techniques to overcome and cope with stress related problems.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1

Self-Awareness & Self-Motivation
Self analysis through SWOT, Johari Window, Maslow’s hierarchy of motivation, importance of self esteem and enhancement of self esteem.

Unit 2

The Nature and Coping of Stress

Unit 3

Application of Health Psychology
Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:
1. V. D. Swaminathan & K. V. Kaliappan “Psychology for effective living - An introduction to Health
REFERENCE BOOKS:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

1. To strengthen the fundamental knowledge of human behavior
2. To strengthen the ability to understand the basic nature and behavior of humans in organizations as a whole
3. To connect the concepts of psychology to personal and professional life

Course Outcome

CO 1: Understand the fundamental processes underlying human behavior such as learning, motivation, individual differences, intelligence and personality.
CO 2: Apply the principles of psychology in day-to-day life for a better understanding of oneself and others.
CO 3: Apply the knowledge of Psychology to improve study skills and learning methods
CO 4: Apply the concepts of defense mechanisms to safeguard against abusive relationships and to nurture healthy relationships.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Psychology of Adolescents: Adolescence and its characteristics.

Unit 2
Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills, Mnemonics.

Unit 3
Attention & Perception: Definition, types of attention, perception.

TEXTBOOKS:

REFERENCE BOOKS:
**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
# Syllabus

## Unit 1

Introduction
Western and Indian views of science and technology
Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science and technology: an overview.

## Unit 2

Indian sciences
Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD

Science and technology under the British rule
Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

## Unit 3

Science and technology in Independent India
Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition
Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.

Conclusion

## REFERENCES:

18. The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.

* The syllabus and the study material in use herein has been developed out of a ‘summer programme’ offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha. ArjunaVishada

Yoga: Arjuna’s Anguish and Confusion – Symbolism of Arjuna’s Chariot.


Unit 2
Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Conceptof Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3


TEXTBOOKS / REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To give students an introduction to the basic ideas contained in the Upanishads; and explores how their message can be applied in daily life for achieving excellence.

Syllabus
Unit 1
An Introduction to the Principal Upanishads and the Bhagavad Gita - Inquiry into the mystery of nature - Sruti versus Smrti - Sanatana Dharma: its uniqueness - The Upanishads and Indian Culture - Upanishads and Modern Science.

Unit 2
The challenge of human experience & problems discussed in the Upanishads – the True nature of Man – the Moving power of the Spirit – The Message of Fearlessness – Universal Man - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different manifestations of consciousness.

Unit 3
Upanishad Personalities - episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada, Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, Chakrayana Ushasti, Raikva, Kapila and Janaka. Important verses from Upanishads - Discussion of Sage Pippalada’s answers to the six questions in Prasnpanishad.

REFERENCES:
1. The Message of the Upanishads by Swami Ranganathananda, Bharatiya Vidya Bhavan
2. Eight Upanishads with the commentary of Sankaracharya, Advaita Ashrama
3. Indian Philosophy by Dr. S. Radhakrishnan, Oxford University Press
4. Essentials of Upanishads by R L Kashyap, SAKSI, Bangalore
5. Upanishads in Daily Life, Sri Ramakrishna Math, Mylapore.
7. Upanishad Ganga series – Chinmaya Creations

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:
- To introduce the significance of food, nutrients, locally available food resources, synergic food combinations, good cooking methods and importance of diversity in foods
- To understand nutritional imbalances and chronic diseases associated with the quality of food.
- To gain awareness about the quality of food - Organic food, genetically modified food, adulterated food, allergic food, food poisoning and food safety.
- To understand food preservation processing, packaging and the use of additives.

Course Outcome:
CO1: Acquire knowledge about the various food and food groups
CO2: Understand nutritional imbalances and chronic diseases prevailing among different age groups.
CO3: Understand the significance of safe food and apply the food safety standards.
CO4: Demonstrate skills of food processing, preservation and packaging methods with or without additives.
CO5: Evaluate the quality of food based on the theoretical knowledge of Food and Nutrition.

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO 2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO 3</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO 4</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO 5</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Syllabus
Unit 1

**Food and Food Groups**
Introduction to foods, food groups, locally available foods, Nutrients, Cooking methods, Synergy between foods, Science behind foods, Food allergies, food poisoning, food safety standards.

*Cookery Practicals - Balanced Diet*

Unit 2

**Nutrients and Nutrition**
Nutrition through life cycle, RDA, Nutrition in disease, Adulteration of foods & Food additives, Packaging and labeling of foods.

*Practicals - Traditional Foods*

Unit 3

**Introduction to Food Biotechnology**
Future foods - Organic foods and genetically modified foods, Fortification of foods, value addition of foods, functional foods, Nutraceuticals, supplementary foods, Processing and preservation of foods, applications of food.
technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Practicals - Value added foods

TEXTBOOKS:

REFERENCE BOOKS:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover this paper intends to give a thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughout in a Japanese class only. Students will be able to make conversations with each other in Japanese. Students can make self-introduction and will be able to write letters in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do Origami – pattern making using paper.

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
**Syllabus**

Students will be taught the third and the most commonly used Japanese script, Kanji. Students will be taught to write as well as speak.

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

Syllabus

Unit 1
Adalitha Kannada: bhashe, swaroopa, belavanigeya kiru parichaya Paaribhaashika padagalu
Vocabulary Building

Unit 2
Prabhandha – Vyaaghra Geethe - A. N. Murthy Rao

Unit 3
Mochi – Bharateepriya
Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa Moodala Mane – Da. Ra. Bendre
Swathantryada Hanate – K. S. Nissaar Ahmed

Unit 4
Letter Writing - Personal: Congratulation, thanks giving, invitation, condolence

Unit 5
Reading Comprehension; nudigattu, gaadegalu Speaking Skills: Prepared speech, pick and speak

REFERENCES:

1. H. S. Krishna Swami Iyangar – Adalitha Kannada – Chetana Publication, Mysuru
2. N. Murthy Rao – Aleyava Mana – Kuvepua Kannada Adyayana Samste
3. Nemi Chandra – Badhuku Badalasabahudu – Navakarnataka Publication
4. Sanna Kathegalu - Prasaranga, Mysuru University, Mysuru
5. B. M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu
6. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.
7. Dr. G. S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.

Syllabus
Unit 1
Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2
Nanna Hanate - Dr. G. S. Shivarudrappa
Ella Marethiruvaga - K. S. Nissaar Ahmed Saviraru Nadigalu – S Siddalingayya

Unit 3

Unit 4
Sarva Sollegala turtu Maha Samelana - Beechi Swarthakkaagi Tyaga - Beechi

Unit 5
Essay writing: Argumentative & Analytical Précis writing

REFERENCES:
1. H. S. Krishnaswami Iyanger – Adalitha Kannada – Chetan Publication, Mysuru
2. Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana
4. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house
5. Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother tongue; to learn our culture & values; to equip students to read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Course Outcome:

After the completion of the course the student will be able to:

CO1: Understand and inculcate philosophical thoughts and practices
CO2: Understand and appreciate the post modern trends of literature.
CO3: Analyse the literary texts and comprehend the cultural diversity of Kerala
CO4: Distinguish the different genres in Malayalam literature
CO5: Demonstrate the ability to effectively communicate in Malayalam

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
Ancient poet trio: Adhyatmaramayanam, Lakshmana Swanthanam (valsa soumitre… mungikidakayal), Ezhuthachan - Medieval period classics –Jnanappana (kalaminnu… vilasangalingane), Poonthanan

Unit 2

Unit 3
Short stories from period 1/2/3, Poovanpazham - Vaikaom Muhammed Basheer - Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4
Literary Criticism: Ithihasa studies - Bharatha Paryadanam - Vyasante Chiri - Kuttkrishna Mararu - Outline of literary Criticism in Malayalam Literature - Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5
Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation – Thettillatha Malayalam
Writing - a. Expansion of ideas; b. Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script/Feature/Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:
To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Course Outcome:
After the completion of the course the student will be able to:

CO1: Understand the different cultural influences in linguistic translation
CO2: Identify and appreciate the Romantic elements of modern literature
CO3: Analyze the genre of autobiographical writing
CO4: Critically evaluate the significance of historical, political and socio cultural aspects in literature
CO5: Demonstrate good writing skills in Malayalam

CO-PO Mapping:

<table>
<thead>
<tr>
<th>PO CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Syllabus
Unit 1

Unit 2

Unit 3
Anthology of short stories from period 3/4/5: Ninte Ormmayku, M. T. Vasudevan Nair - literary contributions of his time

Unit 4
Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattathirippadu - Socio-cultural literature - historical importance.

Unit 5
Error-free Malayalam - 1. Language; 2. Clarity of expression; 3. Punctuation - Thettillatha Malayalam
Writing - a. Expansion of ideas; b. Précis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus

Unit 1
Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2
Verbs- Singular, Dual and plural – First person, Second person, Third person. Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi-kartha-prayoga

Unit 3
Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4
Selected slokas from Valmiki Ramayana, Kalidasa’s works and Bhagavad Gita. Ramayana – chapter VIII - verse5, Mahabharata - chapter 174, verse -16, Bhagavad Gita – chapter - IV verse 8, Kalidasa’s Sakuntalam Act IV – verse 4

Unit 5
Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:
1. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore - 560 085
2. Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Rama Bhandakara by Kashinath Sharma, published by Nirmayasagar press

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus

Unit 1
Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2

Unit 3
Words and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4
Introduction to classical literature, classification of Kavyas, classification of Dramas - The five Mahakavyas, selected slokas from devotional kavyas- Bhagavad Gita – chapter - II verse 47, chapter - IV verse 7, chapter -VI verse 5, chapter - VIII verse 6, chapter - XVI verse 21, Kalidasa’s Sakuntala act IV – verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14 - 120, Neetisara chapter - III

Unit 5
Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:
1. Praveshaha; Publisher: Sanskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalingusasanam by Amarasimha published by Travancore Sanskrit series

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Understanding CSR - Evolution, importance, relevance and justification. CSR in the Indian context, corporate strategy. CSR and Indian corporate. Structure of CSR - In the Companies Act 2013 (Section 135); Rules under Section 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting.

Unit 2
CSR Practices & Policies - CSR practices in domestic and international area; Role and contributions of voluntary organizations to CSR initiatives. Policies; Preparation of CSR policy and process of policy formulation; Government expectations, roles and responsibilities. Role of implementation agency in Section 135 of the Companies Act, 2013. Effective CSR implementation.

Unit 3
Project Management in CSR initiatives - Project and programme; Monitoring and evaluation of CSR Interventions. Reporting - CSR Documentation and report writing. Reporting framework, format and procedure.

REFERENCES:

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1

Unit 2

Unit 3
Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace. Employee and employer obligations, Promoting mental health and well being - corporate social responsibility (CSR), an inclusive work environment. Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals-talking about mental health, making reasonable adjustments, Resources and support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case Study, Activity.

REFERENCES:

3. Canadian Mental Health Association, Ontario “Workplace mental health promotion, A how to guide”vmhp.cmhaontario.ca/
6. Mental Health Act 1987 (India) www.mha.gov.in
7. Persons with disabilities Act 1995 (India) socialjustice.nic.in
8. The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:
- To introduce the students to different literature - Sangam literature, Epics, Bhakthi literature and modern literature.
- To improve their ability to communicate with creative concepts, and also to introduce them to the usefulness of basic grammatical components in Tamil.

Course Outcomes
CO 1: To understand the Sangam literature
CO 2: To understand the creative literature
CO 3: To understand the literary work on religious scriptures
CO 4: To improve the communication and memory skills
CO 5: To understand the basic grammar components of Tamil language and their usage and applications.
CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllabus

Unit 1
The history of Tamil literature: Nāṭṭupuṟap pāṭalkal, kataikkal, pāḷamolikakal - ciṟukataikaḷ tōṟṟamum valarecckiyum, ciṟilakkiyankal: Kaliṅkattup paranip (põrpāṭiyatu) - mukkāṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – manimēkalai nāṭaiyiyal āyvu maṟṟum aimperum – aiṅciṟuñ kāppiyaṅkaḷ toṭarpāṉa ceytkal.

Unit 2
tiṇai ilakkiyamum nittiyilakkiyamum - patiṇešķičkiṇaṅkakku nūlkal toṭarpāṉa piṉa ceytkal - tirukkuṟal (aṉpu, paṉpu, kalvi, oṉukkam, natpu, vāymai, kēḷvi, ceynaṅri, periyāraiṭtunakkōṭal, vilippunaruṉ pēṅga atikāṟattil ulḷa ceytkal).
Aṉaṅnūlkal: Ulakanīti (1-5) – elāti (1,3,6). - Cittarkal: Kaṭuveḷi cittar pāṭalkal (āṉantak kalippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkal (1-5).

Unit 3
tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟu ayarkēṟu

Unit 4

**Unit 5**

**Textbooks:**
6. poṅ maṅiṅmaṅ “atōṅ tamiṇ ilakkaṇam “atōṅ papliṅsiṅ kurūp, vaṅciyūr,

**Evaluation Pattern**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives

- To learn the history of Tamil literature.
- To analyze different styles of Tamil Language.
- To strengthen the creativity in communication, Tamil basic grammar and use of computer on Tamil Language.

Course Outcomes

CO 1: Understand the history of Tamil literature.
CO 2: Apply practical and comparative analyses on literature.
CO 3: Understand Thinai literature, literature on justice, Pathinenkeelkanaku literature.
CO 4: Understand the Tamil scholars' service to Tamil language and society.
CO 5: Understand components of Tamil grammar and its usage.
CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>CO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO11</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PO12</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Syllabus

Unit 1


Unit 2

tinai ilakkiyamum niṭṭiyilakkiyamum - patiṇeṉkēṭkkanakkku nūlkal toṭarpāṉa piṇa ceytiyakal - tirukkuṟṟa (aṇpu, paṇpu, kalvi, oḻukkam, natpu, vāymai, kēḷvi, ceynaṅṛi, periyāṟaitṭunakkoṭal, vilippunarvu peṇa atikārattil ullā ceytiyakal. Āgarūḷkal: Ulakanīti (1-5) - ēlāti (1,3,6). - Cittarkal: Kaṭuveḷi cīt̆tar pāṭalkaḷ (aṉantak kalippu –1, 4, 6, 7, 8), maṟṟum akappēy cīt̆tar pāṭalkaḷ (1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṇai piraviṇai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimāṟṟam - vilampara moḻiyamaippu – pēccu - nāṭakam paṭaippu -
čiṟukatai, katai, putiṇam paṭaippu.

Text Books / References
“tamiḻ ilakkiya varalāṟu” cāhitya aḳaṭemi papḷikēṣaṉs, 2012
nā.Vāṉamāmalai, “tamiḻar nāṭṭuppāṭalkal” niyū ceņcuri puttaka veliyṭṭakam 1964,2006 poṅ maṉimāṟaṉ “aṭōṉ tamiḻ
ilakkaṇam “aṭōṉ papḷiṉ kurūp, vaṇciyū

Evaluation Pattern

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Internal</th>
<th>End Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical 1 (P1)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Periodical 2 (P2)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>*Continuous Assessment (CA)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>End Semester</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

*CA – Can be Quizzes, Assignment, Projects, and Reports.