DEPARTMENT OF MATHEMATICS
ANNA UNIVERSITY, CHENNAI

VISION

We, at the Department of Mathematics, Anna University, Chennai, shall strive constantly to

- Achieve excellence in Mathematics education by providing high quality teaching, research and training in Mathematics to all our students to significantly contribute in the fields of Mathematics, Computer Science and all related Engineering fields.
- Contribute to the quality Human Resource Development in Mathematics and Computer Science through our effective Masters and Research Programmes.

MISSION

- To provide strong Mathematical background to Engineering Students to cope up with the needs of emerging technologies both at National and International levels.
- To popularize and to project the proper perspective of Mathematics and Computer Science towards attracting young talents to take up teaching and research careers in Mathematical Sciences.
ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.Sc. MATHEMATICS (2 years)
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

   I. To make the students in mastering in the fields of Mathematics and prepare them for higher research or to take up professional careers in Mathematical Science.
   
   II. To provide the students with solid foundation in both fundamentals of Mathematics and modern Mathematical Theory with deeper insight on the powerful methods and techniques that can be used within Mathematics and its areas of applications.
   
   III. To train students with logical and analytical thinking so as to comprehend, analyze, design and provide solutions for the real life problems.
   
   IV. To inculcate the students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Mathematical aspects to broader social context.
   
   V. To provide students an academic environment to develop excellence in leadership qualities, practice ethical codes and guidelines, and achieve life-long learning needed for a successful professional career.

2. PROGRAMME OUTCOMES (POs):

   After going through the two years of study, our Mathematics Post-Graduates will exhibit ability to:

<table>
<thead>
<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engineering knowledge</td>
<td>Apply knowledge of mathematics, basic science and engineering science.</td>
</tr>
<tr>
<td>2</td>
<td>Problem analysis</td>
<td>Identify, formulate and solve engineering problems.</td>
</tr>
<tr>
<td>3</td>
<td>Design/development of solutions</td>
<td>Design a system or process to improve its performance, satisfying its constraints.</td>
</tr>
<tr>
<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Conduct experiments &amp; collect, analyze and interpret the data.</td>
</tr>
<tr>
<td>5</td>
<td>Modern tool usage</td>
<td>Apply various tools and techniques to improve the efficiency of the system.</td>
</tr>
<tr>
<td>6</td>
<td>The Engineer and society</td>
<td>Conduct themselves to uphold the professional and social obligations.</td>
</tr>
<tr>
<td>7</td>
<td>Environment and sustainability</td>
<td>Design the system with environment consciousness and sustainable development.</td>
</tr>
<tr>
<td>8</td>
<td>Ethics</td>
<td>Interaction with industry, business and society in a professional and ethical manner.</td>
</tr>
<tr>
<td>9</td>
<td>Individual and team work</td>
<td>Function in a multi-disciplinary team.</td>
</tr>
<tr>
<td>10</td>
<td>Communication</td>
<td>Proficiency in oral and written Communication.</td>
</tr>
<tr>
<td>11</td>
<td>Project management and finance</td>
<td>Implement cost effective and improved system.</td>
</tr>
<tr>
<td>12</td>
<td>Life-long learning</td>
<td>Continue professional development and learning as a life-long activity.</td>
</tr>
</tbody>
</table>
3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

By the completion of the Post Graduate programme in Mathematics the student will have the following Programme specific outcomes.

1. To be able to demonstrate standard mathematical principles and methods.
2. To be able to identify the logical background of real world problems or research problems.
3. To be able to utilize appropriate mathematical tools to solve research level or real world problems.
4. To be able to critically analyse the possible solutions of the emerging mathematical problems.

4. PEO / PO Mapping:

<table>
<thead>
<tr>
<th>PROGRAMME EDUCATIONAL OBJECTIVES</th>
<th>PROGRAMME OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>I</td>
<td>✓</td>
</tr>
<tr>
<td>II</td>
<td>✓</td>
</tr>
<tr>
<td>III</td>
<td>✓</td>
</tr>
<tr>
<td>IV</td>
<td>✓</td>
</tr>
<tr>
<td>V</td>
<td>✓</td>
</tr>
</tbody>
</table>

Mapping of Course Outcome and Programme Outcome

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Course Name</th>
<th>PO01</th>
<th>PO02</th>
<th>PO03</th>
<th>PO04</th>
<th>PO05</th>
<th>PO06</th>
<th>PO07</th>
<th>PO08</th>
<th>PO09</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR 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>Semester 2</td>
<td>Abstract Algebra</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></td>
<td>Advanced Calculus</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></td>
<td>Object Oriented Programming</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></td>
<td>Ordinary Differential Equations</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></td>
<td>Real Analysis</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></td>
<td>Elective I</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></td>
<td>Audit Course – I</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></td>
<td>(One from list of Audit courses)</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></td>
<td>Object Oriented Programming Laboratory</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></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>Semester 2</td>
<td>Classical Mechanics</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></td>
<td>Complex Analysis</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></td>
<td>Linear Algebra</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></td>
<td>Partial Differential Equations</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></td>
<td>Probability and Random Processes</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></td>
<td>Elective II</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></td>
<td>Audit Course – II</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></td>
<td>(One from list of Audit courses)</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></td>
<td>Continuum Mechanics</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>

3
<table>
<thead>
<tr>
<th>YEAR 2</th>
<th>Semester 3</th>
<th>Semester 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Functional Analysis</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Integral Transforms and Calculus of Variations</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Numerical Analysis</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Topology</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Elective III</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Computational Laboratory</td>
<td>✓</td>
</tr>
<tr>
<td>Semester 4</td>
<td>Open Elective</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Elective IV</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Elective V</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Project Work</td>
<td>✓</td>
</tr>
</tbody>
</table>
### SEMESTER I

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L T P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MT5101</td>
<td>Abstract Algebra</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>MT5102</td>
<td>Advanced Calculus</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>MT5103</td>
<td>Object Oriented Programming</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MT5104</td>
<td>Ordinary Differential Equations</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MT5105</td>
<td>Real Analysis</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Program Elective I</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Audit Course – I*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**PRACTICAL**

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L T P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>MT 5111</td>
<td>Object Oriented Programming Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL** 23 0 4 23 23

*Audit course is optional*

### SEMESTER II

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L T P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MT5201</td>
<td>Classical Mechanics</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MT5202</td>
<td>Complex Analysis</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>MT5203</td>
<td>Linear Algebra</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MT5204</td>
<td>Partial Differential Equations</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>MT5205</td>
<td>Probability and Random Processes</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Program Elective II</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Audit Course – II*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL** 23 0 0 23 21

*Audit course is optional*
### SEMESTER III

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MT5301</td>
<td>Continuum Mechanics</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MT5302</td>
<td>Functional Analysis</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MT5303</td>
<td>Integral Transforms and Calculus of Variations</td>
<td>PCC</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>MT5304</td>
<td>Numerical Analysis</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>MT5305</td>
<td>Topology</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Program Elective III</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### PRACTICAL

|        |          |                                                   | PCC      | 0                | 0                      | 4       | 2       |
|        |          |                                                   |          |                  |                        |         |         |
|        |          |                                                   |          |                  |                        |         |         |
|        |          |                                                   |          |                  |                        |         |         |

**TOTAL** 19 0 4 23 21

### SEMESTER IV

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Open Elective</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Program Elective IV</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Program Elective V</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>MT5411</td>
<td>Project Work</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** 9 0 20 29 19

**Total No. of Credits : 84**
## PROGRAM CORE COURSES (PCC)

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
</tr>
<tr>
<td>1.</td>
<td>MT5101</td>
<td>Abstract Algebra</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MT5102</td>
<td>Advanced Calculus</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MT5103</td>
<td>Object Oriented Programming</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>MT5104</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>MT5105</td>
<td>Real Analysis</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>MT5111</td>
<td>Object Oriented Programming Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>MT5201</td>
<td>Classical Mechanics</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>MT5202</td>
<td>Complex Analysis</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>MT5203</td>
<td>Linear Algebra</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>MT5204</td>
<td>Partial Differential Equations</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11.</td>
<td>MT5205</td>
<td>Probability and Random Processes</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12.</td>
<td>MT5301</td>
<td>Continuum Mechanics</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13.</td>
<td>MT5302</td>
<td>Functional Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14.</td>
<td>MT5303</td>
<td>Integral Transforms and Calculus of Variations</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15.</td>
<td>MT5304</td>
<td>Numerical Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.</td>
<td>MT5305</td>
<td>Topology</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17.</td>
<td>MT5311</td>
<td>Computational Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Credits: 56

## PROGRAM ELECTIVE COURSES (PEC)

<table>
<thead>
<tr>
<th>S. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MT5001</td>
<td>Advanced Analysis</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MT5002</td>
<td>Advanced Graph Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MT5003</td>
<td>Algorithmic Graph Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MT5004</td>
<td>Analysis of Heat and Mass Transfer</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MT5005</td>
<td>Boundary Layer Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MT5006</td>
<td>Data Structures</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>MT5007</td>
<td>Design and Analysis of Algorithms</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>MT5008</td>
<td>Discrete Mathematics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>MT5009</td>
<td>Differential Topology</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Sl.No</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>PERIODS PER WEEK</td>
<td>CREDITS</td>
<td>SEMESTER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>------------------</td>
<td>---------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10..</td>
<td>MT5010</td>
<td>Finite Element Method</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MT5011</td>
<td>Finite Volume Method</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>MT5012</td>
<td>Fixed Point Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>MT5013</td>
<td>Fluid Mechanics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>MT5014</td>
<td>Formal Languages and Automata Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>MT5015</td>
<td>Functional Analysis and its Applications to PDE</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>MT5016</td>
<td>Fuzzy Set Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>MT5017</td>
<td>Geometric Function Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>MT5018</td>
<td>Graph Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>MT5019</td>
<td>Introduction to Algebraic Topology</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>MT5020</td>
<td>Introduction to Lie Algebras</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>MT5021</td>
<td>Mathematical Aspects of Finite Element Method</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>MT5022</td>
<td>Mathematical Finance</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>MT5023</td>
<td>Mathematical Programming</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>MT5024</td>
<td>Mathematical Statistics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>MT5025</td>
<td>Networks, Games and Decisions</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>26.</td>
<td>MT5026</td>
<td>Number Theory</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>27.</td>
<td>MT5027</td>
<td>Number Theory and Cryptography</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>28.</td>
<td>MT5028</td>
<td>Numerical Solutions of Partial Differential Equations</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>29.</td>
<td>MT5029</td>
<td>Queueing and Reliability Modeling</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>30.</td>
<td>MT5030</td>
<td>Stochastic Processes</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>31.</td>
<td>MT5031</td>
<td>Theory of Elasticity</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>32.</td>
<td>MT5032</td>
<td>Theory of Wavelets</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
</tr>
<tr>
<td>1</td>
<td>MT5411</td>
<td>Project Work</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Credits:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## OPEN ELECTIVE COURSES (OEC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MP5491</td>
<td>Nuclear Energy in Health Care and Industry</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MP5492</td>
<td>Smart Materials for Energy and Environment Applications</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>EA5491</td>
<td>Climate Journalism</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>EA5492</td>
<td>Digital Photography</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>AC5491</td>
<td>Green Chemistry</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>AC5492</td>
<td>Food Chemistry</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>AG5491</td>
<td>Natural Hazards and Management</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>AG5492</td>
<td>Ocean Resources and Exploration Techniques</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>MC5491</td>
<td>Basic Crystallography and Crystal Growth</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>MC5492</td>
<td>Nonlinear Science</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MT5491</td>
<td>Statistical Methods</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>HS5491</td>
<td>Professional Email Communication</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>HS5492</td>
<td>Project Report Writing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>HS5493</td>
<td>Basic Presentation Skills</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

## AUDIT COURSES (AC)

Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL.NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX5091</td>
<td>English for Research Paper Writing</td>
<td>2 0 0</td>
<td>0</td>
<td>1/2</td>
</tr>
<tr>
<td>2.</td>
<td>AX5092</td>
<td>Disaster Management</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>AX5093</td>
<td>Sanskrit for Technical Knowledge</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>AX5094</td>
<td>Value Education</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>AX5095</td>
<td>Constitution of India</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>AX5096</td>
<td>Pedagogy Studies</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>AX5097</td>
<td>Stress Management by Yoga</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>AX5098</td>
<td>Personality Development through Life Enlightenment Skills</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>AX5099</td>
<td>Unnat Bharat Abhiyan</td>
<td>2 0 0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 0
SUMMARY

<table>
<thead>
<tr>
<th>M. Sc Mathematics</th>
<th>Credits per Semester</th>
<th>Credits Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject Area</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1. PCC</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>2. PEC</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>3. EEC</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4. OEC</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>5. Non Credit/Audit course</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Total Credit</strong></td>
<td>23</td>
<td>21</td>
</tr>
</tbody>
</table>

MT5101  
ABSTRACT ALGEBRA  
L T P C  
4 0 0 4

OBJECTIVES:
- To start with the basic axioms defining a group and then move on to special groups like symmetric groups, cyclic groups, the notion of a subgroup, homomorphism between groups
- To know about more concepts and results like isomorphism theorems, group actions on sets and their applications
- To introduce rings and ideals, their properties
- To learn about a special type of rings, namely polynomial rings with coefficients in a field
- To introduce fields and field extensions and study their properties

UNIT I  
GROUPS  
12
Basic Axioms, Examples of groups - Dihedral Groups, Symmetric groups, Matrix Groups, The Quaternion Group, Homomorphisms and isomorphisms, Subgroups-subgroup criterion, centralizers and normalizers, cyclic groups and cyclic subgroups, Cosets, normal subgroups, quotient groups, Lagrange's theorem.

UNIT II  
MORE ON GROUPS  
12
Isomorphism theorems, permutation groups, Group Actions, Permutation Representations, Cayley’s Theorem, The Class Equation, conjugacy in S_n, Sylow’s Theorem

UNIT III  
RINGS  
12
Basic definitions, Examples-polynomial rings, matrix rings, Ring homomorphisms, ideals, quotient rings, first isomorphism theorem for rings, principal ideal, maximal ideal, prime ideal, their properties Euclidean domains, principal ideal domains, unique factorization domains

UNIT IV  
POLYNOMIAL RINGS  
12
Polynomial Rings, Polynomial Rings over fields, Polynomial Rings that are Unique Factorization Domains, Irreducibility Criteria.
UNIT V FIELDS 12
Fields, Field Extensions, simple extensions, Algebraic extensions, classical Straight-Edge and compass constructions, splitting fields and algebraic closures, the fundamental theorem of algebra

OUTCOMES:
- Students would have learnt the basics of group theory and some important results like Lagrange’s theorem
- Students would have learnt how to use isomorphism between groups to classify certain groups, and study properties of groups using class equation and Sylow’s theorem
- The basics of ring theory, including the knowledge of Euclidean domains, PIDs and UFDs would have been imparted to the students
- Students will be knowledgeable about division algorithm for polynomial rings over a field and about different irreducibility criteria for polynomials
- Students would have learnt about field extensions and some important applications of field extensions

REFERENCES

MT5102 ADVANCED CALCULUS L T P C
OBJECTIVES:
- To introduce the basic notion of applied aspects of analysis and familiarize with the theoretical sides of the subject.
- To distinguish between implicit and explicit functions.
- To find Maxima and Minima using Taylor’s theorem.
- To introduce line integrals and surface integrals.
- To find line integrals in space.

UNIT I PARTIAL DIFFERENTIATION 12
Functions of several variables - Homogeneous functions - Total derivative - Higher order Derivatives, Equality of cross derivatives - Differentials - Directional Derivatives.

UNIT II IMPLICIT FUNCTIONS AND INVERSE FUNCTIONS 12

UNIT III TAYLOR’S THEOREM AND APPLICATIONS 12
Taylor’s theorem for functions of two variables - Maxima and Minima of functions of two and three variables – Lagrange Multipliers.

UNIT IV LINE AND SURFACE INTEGRALS 12
Definition of line integrals - Green’s theorem - Applications - Surface integrals - Gauss theorem - Verification of Green’s and Gauss theorems.

UNIT V TRANSFORMATION AND LINE INTEGRALS IN SPACE 12
Change of variables in multiple integrals - Definition of line integrals in space - Stoke’s theorem - Verification of Stoke’s theorem.

TOTAL: 60 PERIODS
OUTCOMES:
- This course prepares the student to take up other courses in Mathematics. It provides theoretical foundation for calculus of one and several variables at advanced level.
- Should be able to identify dependent and independent variables and Jacobians.
- Should be able to use Taylor’s theorem and Lagrange’s theorem for optimization problems.
- Should be able to verify Green’s and Gauss theorems and apply them to convert line and surface integrals.
- Should be able to verify Stoke’s theorem and apply it for multiple integrals.

REFERENCES

MT5103 OBJECT ORIENTED PROGRAMMING L T P C
3 0 0 3

OBJECTIVE
- The language accommodates several programming paradigms, including object-oriented programming, generic programming, and the traditional procedural programming. It exposes students to modern object-oriented programming techniques that have proved successful in the development of large complex software systems by multiple programmers. It teaches object-oriented design and explores techniques for building modular, efficient and robust systems. The goal of the course is to develop skills such as program design and testing as well as the implementation of programs using object-oriented features.

UNIT I FUNDAMENTALS OF OOP

UNIT II OOP PROGRAMMING IN C++
Classes and objects – creating and accessing class members – Constructor and Destructor – Objects-Member Functions - Inline Function - Friend Functions - Operator Overloading – prefix and postfix, overloading binary operators, instream and outstream operator overloading - Function Templates and Class Templates.

UNIT III INHERITANCE
Introduction - protected data, private data, public data - inheriting constructors and destructors, constructors for virtual base classes, constructors and destructors of derived classes and virtual functions, size of derived class - order of invocation - types of inheritance - single inheritance, hierarchical inheritance, multiple inheritance, hybrid inheritance.

UNIT IV POLYMORPHISM AND VIRTUAL FUNCTIONS
Importance of virtual function, function call binding, virtual functions, implementing late binding, need for virtual functions, abstract base classes and pure virtual functions, virtual destructors.

UNIT V FILES AND STREAMS
Components of a file, file operations, communication in files, creation of file streams, stream classes, header classes, header files, updating of files, opening and closing a file, file pointers and their manipulations, function manipulation of file pointers, detecting end-of-file.

TOTAL: 45 PERIODS
OUTCOMES

- Students will be able to design and write computer programs that are correct, simple, clear, efficient, well organized, and well documented.
- Students will be able to apply programming skills in the areas of pure, applied mathematics and related areas.
- The student will understand the hardware and software aspects of computer systems that support application software development.

REFERENCES


MT5104 ORDINARY DIFFERENTIAL EQUATIONS

OBJECTIVES

- To introduce the methods of solving linear higher order ordinary differential equations.
- To enable the students understand the existence conditions for solution of boundary value problems.
- To introduce the stability aspects of linear and nonlinear systems.
- To demonstrate power series solutions for Legendre equation.
- To discuss the series solution for Bessel equation.

UNIT I LINEAR EQUATIONS

Higher order equations - Linear independence - Wronskian - Variation of parameters - Systems of Linear differential equations - Existence and uniqueness theorem.

UNIT II EXISTENCE THEOREM AND BOUNDARY VALUE PROBLEMS

Successive approximations - Picard’s theorem - Boundary Value problems - Sturm - Liouville problem- Green’s Functions.

UNIT III STABILITY

Autonomous systems - The phase plane - Critical points and stability for linear systems - Stability by Liapunov’s direct method - Simple critical points of non-linear systems.

UNIT IV LEGENDRE EQUATION

Power series solutions - Second order linear equations with ordinary points - Legendre equation - Legendre polynomials - Rodrigue’s formula - Recurrence relations - Orthogonality.

UNIT V BESSEL EQUATION

Second order equations with regular singular points - Series solution - Bessel Equation - Bessel functions of first kind - Recurrence relations - Orthogonality.

TOTAL: 45 PERIODS

OUTCOMES

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

- formulate and solve linear higher order ordinary differential equations.
- analyze the existence of solutions for boundary value problems.
- investigate the stability aspects of autonomous linear and nonlinear systems.
- apply power series solutions to second order linear equations with ordinary points.
- obtain the series solutions to second order linear equations with regular singular points.
REFERENCES

MT5105 REAL ANALYSIS

OBJECTIVES
- Real Analysis is the fundamental behind almost all other branches of Mathematics.
- The aim of the course is to make the students understand the basic concepts of Real analysis.
- To introduce uniform convergence and uniform continuity of sequences and series of functions.
- To introduce a few concepts of measure theory.
- To introduce Riemann and Lebesgue integrability concepts.

UNIT I METRIC SPACES, CONTINUITY AND DIFFERENTIABILITY

UNIT II RIEMANN-STIELTJES INTEGRAL
Definition and existence of the integral - Properties of the integral - Integration and Differentiation.

UNIT III SEQUENCES AND SERIES OF FUNCTIONS
Pointwise convergence - Uniform convergence - Uniform convergence and continuity - Uniform convergence and Integration, Uniform Convergence and differentiation. Equi-continuous families of functions, Weierstrass and Stone-Weierstrass theorem.

UNIT IV MEASURE AND MEASURABLE SETS
Lebesgue Outer Measure - Measurable sets - Regularity - Measurable functions - Abstract Measure - Outer Measure Extension of a Measure – Measure spaces.

UNIT V LEBESGUE INTEGRAL

TOTAL : 60 PERIODS

OUTCOMES
- The students will be able to get a deeper understanding of limits, continuity and differentiability.
- The students should be able to gain another perspective of integral through the Riemann-Stieltjes integral.
- The students should be able to identify the convergence of sequences and series of functions.
- The students will be able to understand the methods of Decomposing signed measures which have applications in probability theory and Functional Analysis.
- The students get introduced to the approach of integration via measure, rather than measure via integration. The students will be able to understand the treatment of Integration in the sense of both Riemann and Lebesgue.
REFERENCES

MT5111 OBJECT ORIENTED PROGRAMMING LABORATORY

OBJECTIVE

- The purpose of this lab course is to develop skills in program designing and testing using C++.
  1. Console I/O operations
  2. Function Overloading
  3. Function Templates and Class Templates in C++
  4. Classes in C++ with all possible operations/operators for encapsulating Complex Number,
  5. String, Time, Date and Matrix (Operators are to be overloaded)
  6. Scope Resolution and Memory Management Operators
  7. Inheritance
  8. Virtual Functions
  9. Friend Functions
  10. Constructors and Destructors
  11. 10. ‘this’ Pointer
  12. File I/O Operations

TOTAL: 60 PERIODS

OUTCOMES

- Students will be able to understand the difference between procedural and object-oriented programming approach.
- Students will be able to implement the mathematical knowledge of analysis.
- Students will be able to program Discrete mathematical structures and related algorithms using object-oriented programming concepts.

REFERENCES
OBJECTIVES

- To introduce the kinematics of objects in motion.
- To demonstrate the methods of dynamics in space.
- To give the methods of solution to the motion of macroscopic objects from projectiles to machinery as well as astronomical objects on the qualitative structure of phase space.
- To introduce the Lagrangean and Hamiltonian structure of mechanics.
- To enable the students apply the Hamiltonian methods of solving dynamical systems.

UNIT I  KINEMATICS
9
Kinematics of a particle and a rigid body - Moments and products of inertia - Kinetic energy - Angular momentum.

UNIT II  METHODS OF DYNAMICS IN SPACE
9
Motion of a particle - Motion of a system - Motion of a rigid body.

UNIT III  APPLICATIONS OF DYNAMICS IN SPACE
9
Motion of a rigid body with a fixed point under no forces - Spinning top - General motion of top.

UNIT IV  EQUATIONS OF LAGRANGE AND HAMILTON
9
Lagrange’s equation for a particle - Simple dynamical system - Hamilton’s equations.

UNIT V  HAMILTONIAN METHODS
9
Natural Motions - Space of events - Action - Hamilton’s principle - Phase space - Liouville’s theorem.

TOTAL: 45 PERIODS

OUTCOMES
At the end of the course, the students will be able to
- deal with kinematics of objects in motion.
- derive the equations of motion of a particle, a system and that of a rigid body.
- apply the dynamics in space to motion of rigid bodies.
- derive the Lagrangean and Hamiltonian equations of motion.
- solve dynamical systems using the Hamiltonian method.

REFERENCES
UNIT I: COMPLEX FUNCTIONS


UNIT II: COMPLEX INTEGRATION

Line integrals - Cauchy’s theorem for rectangle - Cauchy’s theorem for disk - Integral formula - Local properties of analytic functions - Schwartz lemma - Maximum Modulus principle.

UNIT III: CALCULUS OF RESIDUES

Homology - Homologous form of Cauchy’s theorem - Calculus of Residues - Contour integration through residues.

UNIT IV: DOMAIN CHANGING MAPPINGS AND HARMONIC FUNCTIONS

Conformality - Normal family - Riemann mapping theorem – Harmonic Functions - Properties - The mean-value property - Poisson’s Formula - Schwarz’s theorem - Harnack’s principle.

UNIT V: MEROMORPHIC AND ENTIRE FUNCTIONS


TOTAL: 60 PERIODS

OUTCOMES

- The student will get good foundation on complex analysis as well as motivation at advanced level.
- The student will gain an insight into integrating complex functions through Cauchy’s theorem.
- The student will be able to integrate complex functions through residues.
- The student will be able to get in-depth understanding of harmonic functions.
- The student will get a thorough understanding of entire functions.

REFERENCES


MT5203 LINEAR ALGEBRA

OBJECTIVES

- To get a strong background of finite dimensional vector space and linear transformations.
- To analyse the linear functional through characteristic values and polynomials.
- To learn about various invariant subspaces and primary decomposition theorem.
- To study about various canonical forms to solve matrix equations.
- To introduce the idea of distance or length into vector spaces via a much richer structure inner product spaces.

UNIT I: VECTOR SPACES AND LINEAR TRANSFORMATIONS


UNIT II: LINEAR FUNCTIONALS AND ANNIHILATING POLYNOMIALS

Linear Functionals – The Double Dual – Transpose of Linear Transformation – Characteristic Values - Annihilating Polynomials.
UNIT III DIRECT SUM AND THE PRIMARY DECOMPOSITION THEOREM 9
Invariant Subspaces – Direct-Sum Decomposition – Invariant Direct Sums - The primary Decomposition Theorem.

UNIT IV CANONICAL FORMS 9
Triangular Form – Nilpotent Transformations – Jordan form.

UNIT V INNER PRODUCT SPACES 9
Inner products - Inner product spaces - Linear Functionals and Adjoints, - Unitary Operators - Normal Operators.

TOTAL : 45 PERIODS

OUTCOMES
- The students would have developed their knowledge and understanding of the concepts of linear algebra.
- Students will be able to find out matrices corresponding to linear transformations.
- Students will analyse the linear transformations on various subspaces.
- Students will understand various methods of canonical forms and utilize in solving system of equations.
- Students will learn about the inner product spaces and its algebraic properties.

REFERENCES

MT5204 PARTIAL DIFFERENTIAL EQUATIONS L T P C
4 0 0 4

OBJECTIVES
- To introduce the methods of solving first order partial differential equations.
- To enable the students classify the second order partial differential equations.
- To demonstrate the methods of solving initial value problems in vibrating strings.
- To display the methods of solving one and two dimensional diffusion equations.
- To discuss the methods of solving boundary value problems involving Laplace equation.

UNIT I FIRST ORDER EQUATIONS 12
Formation of Partial Differential Equations – Lagrange’s equation - Integral surfaces passing through a given curve - Surfaces orthogonal to a given system of surfaces - Compatible system of equations - Charpit’s method.

UNIT II SECOND ORDER EQUATIONS 12
Classification of second order Partial Differential Equations - Reduction to canonical form - Adjoint operators.

UNIT III HYPERBOLIC EQUATIONS 12
UNIT IV  PARABOLIC EQUATIONS  12
Diffusion equation - Method of Separation of variables: Solution of one and two dimensional Diffusion
equations in Cartesian coordinates and Solution of Diffusion equation in cylindrical and spherical polar
coordinates.

UNIT V  ELLIPTIC EQUATIONS  12
Boundary value problems - Properties of harmonic functions - Green's Function for Laplace Equation -
The Methods of Images - The Eigen function Method.

OUTCOMES
At the end of the course, the students will be able to
• solve various types of first order partial differential equations
• classify the second order partial differential equations
• solve initial value problems in vibrating strings
• solve one-dimensional and two-dimensional diffusion equations
• solve boundary value problems involving Laplace equation.

REFERENCES

MT5205  PROBABILITY AND RANDOM PROCESSES  L T P C
4 0 0 4

OBJECTIVES
• To understand the basics of random variables with emphasis on the standard discrete and
  continuous distributions.
• To understand the basic probability concepts with respect to two dimensional random variables
  along with the relationship between the random variables and the significance of the Central
  Limit theorem.
• To learn the classifications of random processes with emphasis on stationarity of various orders
  along with strict sense stationarity, wide-sense stationarity and ergodicity.
• To understand the concepts of correlation functions and power spectral density and their
  properties.
• To be able to apply the knowledge gained so far with respect to linear systems with random
  inputs.

UNIT I  RANDOM VARIABLES  12
Discrete and continuous random variables – Moments – Moment generating functions – Binomial,
Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a random
variable.

UNIT II  TWO-DIMENSIONAL RANDOM VARIABLES  12
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear
regression – Transformation of random variables – Central limit theorem (for independent and
identically distributed random variables).
UNIT III  RANDOM PROCESSES  12

UNIT IV  CORRELATION AND SPECTRAL DENSITIES  12
Auto-correlation functions – Cross-correlation functions – Properties – Power spectral density – Cross-
spectral density – Properties.

UNIT V  LINEAR SYSTEMS WITH RANDOM INPUTS  12
Linear time invariant system – System transfer function – Linear systems with random inputs –
Auto-correlation and Cross-correlation functions of input and output – White noise.

TOTAL: 60 PERIODS

OUTCOMES
• To analyze the performance in terms of probabilities and distributions achieved by the
determined solutions
• To be familiar with some of the commonly encountered two dimensional random variables and
be equipped for a possible extension to multivariate analysis
• To appreciate wide sense stationarity with respect to Poisson and Random Telegraph processes
• To gain proficiency in determining the correlation functions and spectral density characteristics of
random processes
• To demonstrate the specific applications to linear systems with random inputs and white noise
models.

REFERENCES
2. George R. Cooper, Clare D. McGillem, “Probabilistic Methods of Signal and System Analysis”,
3. Hwei Hsu, “Schaum’s Outline of Theory and Problems of Probability, Random Variables and

MT5301  CONTINUUM MECHANICS  L T P C
3 0 0 3

OBJECTIVES:
• To introduce the indicial notations and fundamentals of tensor algebra for continuum mechanics.
• To enable the students understand the kinematics of a continuum in material and spatial
descriptions.
• To introduce the concept of stress tensor and its properties.
• To demonstrate the infinitesimal theory of linear isotropic elastic materials.
• To discuss the flow of Newtonian viscous fluids.

UNIT I  TENSORS  9
Summation Convention – Manipulation in Indicial notations - Components of a tensor –
Transformation laws - Symmetric & anti-symmetric tensors - Principal values and directions - Scalar
invariants.
UNIT II KINEMATICS OF A CONTINUUM
Material and Spatial descriptions - Material derivative - Deformation - Principal Strain - Rate of deformation - Conservation of mass - Compatibility conditions.

UNIT III STRESS TENSOR
Stress vector and tensor - Components of a stress tensor - Symmetry - Principal Stresses – Equations of motion - Boundary conditions – Integral formulation of general principals of mechanics.

UNIT IV LINEAR ELASTIC SOLIDS

UNIT V NEWTONIAN VISCOUS FLUIDS
Equations of hydrostatics - Newtonian fluid - Boundary conditions - Stream lines – Examples of laminar flows - Vorticity vector - Irrotational flow.

TOTAL : 45 PERIODS

OUTCOMES
At the end of the course, the students will be able to
- mathematically manipulate with indicial notations and understand the concept of tensors.
- understand the strain and rate of deformation tensors of a continuum
- obtain the equations of the basic principles of continuum mechanics.
- derive the equations of the infinitesimal theory of elasticity and solve in specific applications.
- derive the equations of motion of linear viscous fluids and solve in specific geometries.

REFERENCES

MT5302 FUNCTIONAL ANALYSIS

OBJECTIVES
- To teach the fundamentals of Functional Analysis.
- The topics include Hahn-Banach theorem, Open mapping theorem, Closed graph theorem, Riesz-Representation theorem etc.
- To introduce inner product spaces and get to Hilbert spaces.
- To study the properties of operators on Hilbert spaces.
- To introduce fixed point theorem and spectral theorem.

UNIT I BANACH SPACES

UNIT II FUNDAMENTAL THEOREMS IN NORMED LINEAR SPACES
Hahn-Banach theorem –Adjoint operator – Reflexive spaces – Baire’s category theorem - Uniform boundedness theorem – Strong and weak convergence - Open mapping theorem - Closed graph theorem.
UNIT III  HILBERT SPACES

UNIT IV  OPERATOR ON A HILBERT SPACE

UNIT V  SPECTRAL AND FIXED POINT THEOREMS
Banach fixed point theorem – Applications of Banach theorem to differential and integral equations - Spectral theorem in finite dimensional spaces.

OUTCOMES
- The student will be in a position to take up advance courses in analysis.
- The student will be able to apply the concepts and theorems for studying numerical analysis, design maturity, the evolution of the design and the complexity of the mission etc.
- The student will be able to use orthogonalization process to various problems.
- The student will be able to use operators on Hilbert space.
- The student will be able to apply the fixed point theorem to solve differential equations and integral equations.

REFERENCES

MT5303 INTEGRAL TRANSFORMS AND CALCULUS OF VARIATIONS

OBJECTIVES
- To familiarize the students in the field of ordinary and partial differential equations to solve boundary value problems associated with engineering applications.
- To introduce integral transform techniques.
- To show the application of integral transforms for solution of linear ODEs and standard PDEs.
- To expose the students to variational formulation and numerical integration techniques
- To demonstrate solution methodology for the variational problems.

UNIT I  LAPLACE TRANSFORMS
Transforms of elementary functions - Unit step and Dirac delta functions - Properties - Differentiation and integration of transforms - Periodic functions - Initial & final value theorems - Inverse Laplace transforms - Convolution theorem - Error function - Transforms involving Bessel functions.

UNIT II  FOURIER TRANSFORMS
Fourier integral representation - Fourier transform pairs - Properties - Fourier sine and cosine transforms - Transforms and inverse transforms of elementary functions - Convolution theorem - Transforms of derivatives.
UNIT III APPLICATIONS OF TRANSFORMS
Application of Laplace Transforms - Evaluation of integrals - Solution of Linear ODE - Applications of Fourier Transforms – wave equation - Heat equation on infinite and semi-infinite line - Potential problems in half-plane.

UNIT IV VARIATIONAL PROBLEMS
Variation of a functional and its properties - Euler’s equations - Functionals with several arguments - Higher order derivatives - Functionals dependent on functions of several independent variables - Variational Problems in Parametric form.

UNIT V MOVING BOUNDARIES AND DIRECT METHODS IN VARIATIONAL PROBLEMS

TOTAL: 60 PERIODS

OUTCOMES
At the end of the course, the students will be able to
- develop the mathematical models of applied mathematics and mathematical physics.
- understand integral transform techniques.
- apply integral transforms for solving linear ODEs and standard PDEs.
- give variational formulation of any differential equation.
- solve different variational problems.

REFERENCES

MT5304 NUMERICAL ANALYSIS

OBJECTIVES
- The aim of the course is to make the students understand the mathematical concepts of numerical methods, their implementation and analysis.
- To introduce the concept of differentiation and integration through numerical methods.
- To introduce approximation techniques for polynomials.
- To introduce various numerical methods for solving ordinary differential equations.
- To introduce various numerical methods for solving partial differential equations.

UNIT I SYSTEMS OF LINEAR EQUATIONS AND ALGEBRAIC EIGENVALUE PROBLEMS

UNIT II INTERPOLATION, DIFFERENTIATION AND INTEGRATION
Interpolation: Lagrange’s and Newton's forward interpolations - Errors in interpolation-Numerical differentiation by finite differences - Numerical Integration: Trapezoidal, Simpson’s and Error in quadratures.
UNIT III APPROXIMATION OF FUNCTIONS 9
Norms of functions - Best Approximations: Least squares polynomial approximation - Approximation with Chebyshev polynomials - Piecewise Linear & Cubic Spline approximation.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 9

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 9
Elliptic equations: Five point finite difference formula in rectangular region - Truncation error; One-dimensional Parabolic equation: Explicit and Crank-Nicholson schemes; Stability of the above schemes - One-dimensional Hyperbolic equation: Explicit scheme.

TOTAL: 45 PERIODS

OUTCOMES
• The students will be able to understand, analyze and solve various problems arising in Science and Engineering numerically.
• The students will be able to solve differentiation and integration problems numerically.
• The students will be able to approximate functions using least square method, cubic spline technique etc.
• The students will be able to solve ordinary differential equations through a variety of numerical techniques.
• The students will be able to undertake the study of advanced courses like Numerical solution of Partial Differential Equations, Functional Analysis and its applications to Partial Differential Equations.

REFERENCES

MT5305 TOPOLOGY

OBJECTIVES
• To introduce the basic notion of a topological space.
• To introduce the concept of continuous mappings between topological spaces.
• To introduce the basics of connectedness and compactness of a topological space.
• To teach them the countability and separation axioms.
• To give an introduction to Urysohn metrization theorem and Tychonoff theorem.
UNIT I  TOPOLOGICAL SPACES
Topological spaces - Basis for a topology - Product topology on finite Cartesian products - Subspace topology.

UNIT II  CLOSED SETS AND CONTINUOUS FUNCTIONS
Closed sets and Limit points - Continuous functions - Homeomorphism - Metric Topology - Uniform limit theorem.

UNIT III  CONNECTEDNESS AND COMPACTNESS
Connected spaces - Components - Path components - Compact spaces - Limit point compactness - Local compactness.

UNIT IV  COUNTABILITY AND SEPARATION AXIOMS

UNIT V  URYSOHN LEMMA AND TYCHONOFF THEOREM
Urysohn lemma - Urysohn metrization theorem - Imbedding theorem - Tietze extension theorem - Tychonoff theorem.

TOTAL : 45 PERIODS

OUTCOMES
• The students will get good foundation for future study in analysis and in geometry.
• The students will be able to know more about topological spaces and their properties.
• The students will get in-depth knowledge on topological properties through connected spaces.
• The students will be able to distinguish between different spaces.
• The students will be able to relate different spaces through Urysohn lemma and such.

REFERENCES

MT5311  COMPUTATIONAL LABORATORY

OBJECTIVE
• To have exposure and usage to software packages such as MATLAB, SPSS and TORA for mathematical computations in Numerical methods, Statistics and Operations research respectively.

C or C++ PROGRAMS
1. Program on Matrix manipulation
2. Program to solve a system of linear equations using Gauss Elimination method
3. Program to solve a system of linear equations using Seidel method
4. Program to solve a system of linear equations using Gauss Jordan method
5. For a given matrix, find the eigenvalue and eigenvector using Power Method

MATLAB PROGRAMS
6. Newton’s Forward and Backward Method
7. Newton’s Divided Difference
8. Simpson 1/3 and 3/8 Method
9. Program on ordinary differential equation
10. Program on Quadratic Equations
11. Splines
12. 2D Graphs
13. 3D Graphs
14. Program on Statistical Data Analysis
15. Program to Animation

TORA

16. Program on Simplex method
17. Program on transportation model
18. Program on linear programming
19. Program on Big M method
20. Program on Integer Programming
21. Program on Graph Theory (Traversal)

TOTAL: 60 PERIODS

OUTCOME
- Students will be capable of handling any mathematical techniques using MATLAB, SPSS and TORA.

REFERENCES:

MT5001 ADVANCED ANALYSIS

(L T P C)
3 0 0 3

(Prerequisite: An introductory course in Real Analysis)

OBJECTIVES:
- Real Analysis is the fundamental behind almost all other branches of Mathematics.
- The aim of the course is to make the students understand the basic and advanced concepts of Real analysis.
- To introduce the concept of differentiation through measures.
- To introduce the Fourier transforms and its properties.
- To introduce the concept of Holomorphic Fourier transforms.

UNIT I L^P SPACES
Convex functions and inequalities – The L^p spaces – Approximation by continuous functions Trignometric Series completeness of trigonometric system.

UNIT II COMPLEX MEASURES
Total variation - Absolute continuity, Consequences of the Radon-Nikodym theorem – Bounded linear functionals on L^p - The Riesz representation theorem.

UNIT III DIFFERENTIATION AND PRODUCT SPACES
Derivatives of measures - The fundamental theorem of calculus - Differentiable transformations - Measurability on Cartesian Products-Product measures-Fubini’s Theorem - Convolutions.

UNIT IV FOURIER TRANSFORMS

UNIT V HOLOMORPHIC FOURIER TRANSFORMS
Introduction - Two theorems of Paley and Wiener - Quasi-analytic classes - The Denjoy Carleman theorem.

TOTAL : 45 PERIODS
OUTCOMES

- The students get introduced to the classical Banach spaces.
- The students will get good understanding of methods of decomposing signed measures which has applications in probability theory and Functional Analysis.
- The students will be able to use measure theory for differentiation.
- The students will get good understanding of Fourier Transform and its Holomorphic extensions.
- The students will be able to analyze Holomorphic Fourier Transforms.

REFERENCES


MT5002 ADVANCED GRAPH THEORY

L T P C
3 0 0 3

(Prerequisite: An introductory course in Graph Theory)

OBJECTIVES:

- To introduce edge coloring of graphs as well as line graphs and their relation.
- To provide exposure on Graph Ramsey Theory.
- To demonstrate the importance of computing eigenvalues of graphs in relevance to understand the structural property of graphs.
- To explain the significance of connectedness in digraphs.
- To provide exposure to the special digraph tournaments and their structural property.

UNIT I LINE GRAPHS AND EDGE-COLORING

Edge coloring, Characterization of Line Graphs.

UNIT II RAMSEY THEORY

Ramsey’s Theorem - Ramsey Numbers - Graph Ramsey Theory - Sperner’s Lemma and Bandwidth.

UNIT III EIGENVALUES OF GRAPHS

The Characteristic Polynomial - Linear Algebra of Real Symmetric Matrices - Eigenvalues and Graph Parameters - Eigenvalues of Regular Graphs - Eigenvalues and Expanders - Strongly Regular Graphs.

UNIT IV CONNECTEDNESS IN DIGRAPHS

Digraphs - Connected and Disconnected digraphs - Strong digraphs - Digraphs and matrices.

UNIT V TOURNAMENTS

Properties of tournaments - Hamiltonian tournaments - Score Sequences.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Able to apply edge coloring idea in solving real world problems relevant to partitioning.
- Able to apply graph ramsey theory principles in solving combinatorial problems.
- Able to compute eigenvalues of graphs and use them for structural studies.
- Able to understand connectedness in digraphs in various applications of digraphs.
- Able to apply graph tournament ideas in solving game tournament related problems.
REFERENCES

MT5003 ALGORITHMIC GRAPH THEORY

(L T P C)
3 0 0 3

(Prerequisite: Graph Theory)

OBJECTIVES
- To introduce fundamentals of Graph Algorithms
- To provide exposure to planarity algorithm and Network flow algorithm.
- To provide algorithmic aspect of Graph Traversal problems.
- To give exposure to graph coloring and its significance.
- To introduce graph problems and their computational challenges.

UNIT I INTRODUCTION TO GRAPHS AND ALGORITHMIC COMPLEXITY

UNIT II PLANAR GRAPHS AND NETWORK FLOW
Basic properties of planar graphs - Genus, crossing-number and thickness - Characterizations of planarity - Planarity testing algorithm - Networks and flows - Maximizing the flow in a network - Menger’s theorems and connectivity - Minimum cost flow algorithm.

UNIT III GRAPH TRAVERSALS AND MATCHINGS

UNIT IV GRAPH COLOURING
Dominating sets, independent sets and cliques - Edge Coloring - Vertex Coloring - Chromatic polynomials - Five colour theorem - Four colour theorem.

UNIT V GRAPH PROBLEMS AND INTRACTABILITY
Introduction to NP - Completeness - Classes P and NP - NP - Completeness and Cook’s theorem - Problems of Vertex cover - Problem of Independent set and clique - Problems of Hamiltonian paths and circuits and the traveling salesman problem - Problems concerning the coloring of graphs.

TOTAL : 45 PERIODS

OUTCOMES
At the end of the course, students will be able to
- Apply fundamental graph algorithms to solve certain optimization problems.
- Apply network flow algorithm and planarity testing algorithms in real world application problems.
- Use Eulerian circuit algorithm to solve certain traversal problems.
- Use graph coloring ideas in Graph partitioning and scheduling related problems.
- Understand the challenges in efficient algorithmic design of various graph problems.

REFERENCES
MT5004  ANALYSIS OF HEAT AND MASS TRANSFER

(Prerequisite: Continuum Mechanics)

OBJECTIVES
- To enable the students understand the concepts of heat and mass transfer and its applications.
- To demonstrate the properties of heat conduction in solving heat equations.
- To introduce the methods of solving flow along surfaces and in channels.
- To familiarize the students with the properties of free and forced convection in laminar flows
- To present the basic ideas of mass transfer in real life problems.

UNIT I  FLOW ALONG SURFACES AND IN CHANNELS  9
Boundary layer and turbulence - Momentum equation - Laminar flow boundary layer equation - Plane plate in longitudinal flow - Pressure gradients along a surface – Exact solutions for a flat plate.

UNIT II  FORCED CONVECTION IN LAMINAR FLOW  9
Heat flow equation - Energy equation - Plane plate in laminar longitudinal flow - Arbitrarily varying wall temperature - Exact solutions of energy equation.

UNIT III  FORCED CONVECTION IN TURBULENT FLOW  9
Analogy between momentum and heat transfer - Flow in a tube - Plane plate in turbulent longitudinal flow - Recent developments in the theory of turbulent heat transfer.

UNIT IV  FREE CONVECTION  9
Laminar heat transfer on a vertical plate and horizontal tube - Turbulent heat transfer on a vertical plate - Derivation of the boundary layer equations - Free convection in a fluid enclosed between two plane walls - Mixed free and forced convection.

UNIT V  MASS TRANSFER  9
Diffusion - Flat plate with heat and mass transfer - Integrated boundary layer equations of mass transfer - Similarity relations for mass transfer - Evaporation of water into air.

TOTAL: 45 PERIODS

OUTCOMES
At the end of the course, the students will be able to
- solve heat conduction problems and obtain numerical solutions.
- solve the problems of flow along surfaces and in channels.
- apply finite element method to solve complex problems in free and forced convection flows.
- apply the fluid flow equations to various flow situations with different boundary conditions.
- analyze the mass transfer properties in various fluid flow problems.

REFERENCES

MT5005  BOUNDARY LAYER THEORY

(Prerequisite: Continuum Mechanics)

OBJECTIVES
- To give a comprehensive overview of the boundary layer theory
- To apply the theory to all areas of fluid mechanics with emphasis on the laminar flow past bodies
- To derive the boundary layer equations and study their properties
- To obtain exact and approximate solutions for specific boundary layer flows
- To enable the students understand the turbulent boundary layer flows.
UNIT I DERIVATION AND PROPERTIES OF NAVIER-STOKES EQUATIONS  
Description of flow fields - Continuity and momentum equations - General stress state - State of deformation - Relation between stresses and deformation - Stokes hypothesis - Derivation of N-S equations - Similarity laws - Limiting cases.

UNIT II EXACT SOLUTIONS OF NAVIER-STOKES EQUATIONS  
Steady plane flows- Couette - Poiseuille flows - Plane stagnation point flow - Steady axisymmetric flows - Hagen - Poiseuille flow - Flow between two concentric rotating cylinders - Axisymmetric stagnation flow - First and second Stokes problems.

UNIT III PROPERTIES AND EXACT SOLUTIONS OF BOUNDARY LAYER EQUATIONS  
Boundary layer equations - Wall friction, separation and displacement - Dimensional Representation - Friction drag - Plate boundary layer- Compatibility conditions at the wall - Similar solutions of the boundary layer equations - Integral relations of the boundary layer.

UNIT IV APPROXIMATE METHODS FOR SOLVING BOUNDARY LAYER EQUATIONS  
Integral methods - Comparison between approximate and exact solutions - Boundary layer control - Continuous suction and blowing- Two dimensional and Axisymmetric boundary layers.

UNIT V FUNDAMENTALS OF TURBULENT FLOWS  
Turbulent flow - Introduction - Mean motion and fluctuations - Basic equations for the mean motion - Boundary layer equations for plane flows - Prandtl’s mixing length theory.

TOTAL : 45 PERIODS

OUTCOMES  
At the end of the course, the students will be able to
- derive the governing equations of any flow problem
- determine the exact solutions for flows in specific geometries
- formulate the boundary layer flows and analyze their properties
- demonstrate the exact and approximate methods of solutions of boundary layer flows and
- distinguish between laminar and turbulent boundary layer flows.

REFERENCES  

MT5006 DATA STRUCTURES L T P C 3 0 0 3

OBJECTIVES  
The emphasis of this course is on the organization of information, the implementation of common data structures such as arrays, stacks, queues, linked lists, binary trees, heaps, balanced trees and graphs.
- The course explores the implementation of these data structures (both array-based and linked representations) and examines classic algorithms that use these structures for tasks such as sorting, searching and hashing.

UNIT I STACKS AND RECURSION  
Arrays : Array as an ADT, One-dimensional Arrays, Two-dimensional Array and Muti-dimensional Arrays - Structures and Unions - Stacks in C: Definition, Representation, Infix to Postfix conversion, Evaluating Postfix expression - Recursion in C.

UNIT II QUEUES AND LISTS  
UNIT III  TREES  9

UNIT IV  SORTING & SEARCHING  9
Sorting: General background - Exchange sorts - Selection and Tree sorting - Insertion sorts – Merge and Radix sorts.
Searching : Basic search Technique - Sequential search, Indexed Sequential search and Binary Search - Tree searching.

UNIT V  GRAPH AND THEIR APPLICATIONS  9
Graphs - Representation and their Application - Linked Representation of Graphs – Graph Traversal: DFS - BFS and Spanning Forest.

TOTAL : 45 PERIODS

OUTCOMES
- Students will be able to understand the abstract properties of various data structures.
- Students will be able to implement data structures in more than one manner and recognize the advantages and disadvantages of the same in different implementations.
- Students will be able to compare the efficiency of algorithms in terms of both time and space.

REFERENCES
UNIT IV STRING MATCHING

UNIT V NP COMPLETENESS

OUTCOMES
At the end of the course, students will be able to
- Describe the complexity of algorithm with appropriate asymptotic notations.
- Use efficient sorting algorithms with comparison as the basic operation for solving sorting problems.
- Use the fundamental graph algorithms in solving optimization problems.
- Use efficient string matching algorithms in string matching problems.
- Able to recognize the complexity class of the given computational problems.

REFERENCES

MT5008 DISCRETE MATHEMATICS

OBJECTIVES
- To introduce Mathematical logic and their use in formal proofs.
- To provide introduction to integer algorithms and their applications.
- To give exposure to fundamental counting principles in combinatorics.
- To explain the method of solving recurrence relations.
- To introduce Boolean algebra and its use in designing Boolean circuits.

UNIT I LOGIC
Propositions - Implications - Equivalence - Normal Forms - Predicates and Quantifiers - Nested Quantifiers - Methods of Proof - Mathematical Induction.

UNIT II NUMBER THEORY
The Integers and Division - Integers and Algorithms - Applications of Number Theory.

UNIT III COUNTING

UNIT IV RECURRENCE RELATIONS
Solving Recurrence Relations - Divide-and-Conquer Algorithms and Recurrence Relations - Generating Functions.

UNIT V BOOLEAN ALGEBRA
Boolean Functions - Representing Boolean Functions - Logic Gates - Minimization of Circuits.

TOTAL: 45 PERIODS
OUTCOMES
At the end of the course, students will be able to
• Validate the logical arguments and the formal proof of theorems
• Apply integer algorithms in solving number theoretic problems.
• Apply the basic counting techniques in solving combinatorial related problems.
• Solve recurrence relations which appear in various applications.
• Apply Boolean laws to design optimal circuits.

REFERENCES

MT5009  DIFFERENTIAL TOPOLOGY  L T P C
            3 0 0 3  

(Prerequisite: Topology and Advanced Calculus)

OBJECTIVES
• To introduce smooth manifolds and to do calculus on manifolds.
• To introduce manifolds with boundary and intersection theory.
• To introduce the concept of orientation and oriented intersection theory.
• To introduce the Hopf degree theorem.
• To introduce the concept of integration on manifolds.

UNIT I  MANIFOLDS AND SMOOTH MAPS  9
Definitions, derivatives and tangents, inverse function theorem, immersions, submersions, transversality, Homotopy and stability, Sard’s theorem

UNIT II  TRANSVERSALITY AND INTERSECTION  9
Manifolds with boundary, one manifolds, Transversality, intersection theory mod 2.

UNIT III  ORIENTED INTERSECTION THEORY  9
Orientation, Oriented intersection number, Lefschetz fixed point theorem.

UNIT IV  HOPF DEGREE THEOREM  9
Poincare Hopf index theorem, isotopy lemma, Hopf degree theorem.

UNIT V  INTEGRATION ON MANIFOLDS  9
Exterior algebra, differential forms, integration on manifolds.

TOTAL: 45 PERIODS

OUTCOMES
• Students will have a thorough knowledge of differential topology. Manifolds appear in many areas like mathematics, physics and students will be able to solve problems involving manifolds.
• The students will gain an understanding of manifolds with boundary.
• The students will get more knowledge on orientation intersection theory.
• The students will gain a thorough understanding of Hopf Degree theorem.
• The students will be able to perform integration on manifolds.

REFERENCES
MT5010  FINITE ELEMENT METHOD  L T P C  3 0 0 3

OBJECTIVES
- To introduce the integral formulations and variational methods of solving boundary value problems.
- To enable the students understand various steps in the finite element method of solution.
- To demonstrate finite element method of solution to time-dependent problems in one-dimension.
- To discuss the finite element method of solution to time-dependent problems in two-dimensions.
- To analyze various measures of errors, convergence and accuracy of solution.

UNIT I  INTEGRAL FORMULATIONS AND VARIATIONAL METHODS  9
Weighted integral and weak formulations of boundary value problems - Rayleigh-Ritz method - Method of weighted residuals.

UNIT II  FINITE ELEMENT ANALYSIS OF ONE-DIMENSIONAL PROBLEMS  9
Discretization of the domain - Derivation of element equations - Connectivity of elements - Imposition of boundary conditions - Solution of equations.

UNIT III  EIGENVALUE AND TIME DEPENDENT PROBLEMS IN ONE DIMENSION  9
Formulation of eigenvalue problem - Finite element models - Applications of semi discrete finite element models for time-dependent problems - Applications to parabolic and hyperbolic equations.

UNIT IV  FINITE ELEMENT ANALYSIS OF TWO-DIMENSIONAL PROBLEMS  10
Interpolation functions - Evaluation of element matrices - Assembly of element equations - Imposition of boundary conditions - Solution of equations - Applications to parabolic and hyperbolic equations.

UNIT V  FINITE ELEMENT ERROR ANALYSIS  8
Interpolation Functions - Numerical Integration and Modeling Considerations - Various measures of errors - Convergence of solution - Accuracy of solution.

TOTAL: 45 PERIODS

OUTCOMES
At the end of the course, the students will be able to
- construct integral formulations of boundary value problems
- implement Finite Element Method for one-dimensional problems
- formulate eigenvalue problems and time-dependent problems in one-dimension
- implement finite element method to time dependent problems in two-dimensions
- perform the finite element error analysis.

REFERENCES

MT5011  FINITE VOLUME METHOD  L T P C  3 0 0 3

OBJECTIVES
- To introduce the ideas of conservation laws and governing equations of fluid flows.
- To demonstrate the finite volume method for diffusion and convection-diffusion problems.
- To present the solution algorithms for momentum equations.
- To exhibit the finite volume methods of solving unsteady flows.
- To extend the ideas to problems in complex geometries.
UNIT I  CONSERVATION LAWS AND BOUNDARY CONDITIONS  9

UNIT II  FINITE VOLUME METHOD FOR DIFFUSION & CONVECTION-DIFFUSION PROBLEMS  9

UNIT III  SOLUTION ALGORITHMS FOR PRESSURE-VELOCITY LINKED EQUATIONS  9
Staggered grid - momentum equations - SIMPLE, SIMPLER, SIMPLEX algorithms – PISO algorithm - Solution of discretised equation: Multigrid techniques.

UNIT IV  FINITE VOLUME METHOD FOR UNSTEADY FLOWS  9
One-dimensional unsteady heat conduction: Explicit - Crank-Nicolson - fully implicit schemes - Implicit method for two and three dimensional problems - transient convection - Diffusion equation and QUICK differencing scheme - Solution procedures for unsteady flow calculations and implementation of boundary conditions.

UNIT V  METHOD WITH COMPLEX GEOMETRIES  9
Body-fitted co-ordinate grids for complex geometries - Cartesian Vs. Curvilinear grids difficulties in Curvilinear grids - Block-structured grids - Unstructured grids and discretisation in unstructured grids - Discretisation of the diffusion term - Discretisation of convective term - Treatment of source terms - Assembly of discretised equations - Pressure-velocity coupling in unstructured meshes - Staggered Vs. co-located grid arrangements - Face velocity interpolation method to unstructured meshes.

TOTAL: 45 PERIODS

OUTCOMES
At the end of the course, the students will be able to
• understand the conservation laws and governing equations of fluid flows.
• apply finite volume method for diffusion and convection-diffusion problems.
• solve momentum equations after discretizing.
• learn the finite volume methods of solving unsteady flows.
• use finite volume methods to solve problems in complex geometries.

REFERENCES
UNIT I  METRIC CONTRACTION PRINCIPLES  9

UNIT II  HYPERCONVEX SPACES AND NORMAL STRUCTURES IN METRIC SPACES  10
Hyperconvexity - Properties of hyperconvex spaces - A fixed point theorem - Approximate fixed points. Normal structures in metric spaces: A fixed point theorem - Structure of the fixed point set - Fixed point set structure - Separable case.

UNIT III  CONTINUOUS MAPPING IN BANACH SPACES  10
Brouwer’s theorem - Further comments on Brouwer’s theorem - Schauder’s Theorem - Stability of Schauder’s Theorem - Leray-Schauder degree - Condensing mappings - Continuous mappings in hyperconvex spaces.

UNIT IV  METRIC FIXED POINT THEORY  8
Contraction mappings - Basic theorems for non-expansive mappings - Structure of the fixed point set - Asymptotically regular mappings - Set valued mappings.

UNIT V  ASYMPTOTIC NONEXPENSIVENESS AND DEMICLOSEDNESS  8
Some fixed point theorem - Asymptotically non expansive mappings - The demiclosedness principle.

TOTAL : 45 PERIODS

OUTCOMES

- The student will be able to apply fixed point theory in various branches of applied mathematics.
- The student will gain more in-depth understanding of metric spaces and hyperconvex spaces.
- The student will be able to apply continuous mappings in hyperconvex spaces.
- The student will be able to further apply contraction mappings and fixed point theorems.
- The student will have a thorough understanding of some more fixed point theorems and their applications.

REFERENCES

MT5013  FLUID MECHANICS  L T P C
3 0 0 3
(Prerequisite: Continuum Mechanics)

OBJECTIVES:

- To give a comprehensive overview of basic concepts of fluid mechanics.
- To introduce the concepts in kinematics and kinetics of fluid flows.
- To enable the students to understand the two-dimensional flows in various geometries.
- To introduce the hydrodynamical aspects of conformal transformation.
- To demonstrate various viscous fluid flows.

UNIT I  KINEMATICS OF FLUIDS IN MOTION  9
UNIT II EQUATIONS OF MOTION OF A FLUID
Pressure at a point in a fluid – Boundary conditions of two inviscid immiscible fluids – Euler’s equations of motion – Bernoullí’s equation – Some potential theorems – Flows involving axial symmetry.

UNIT III TWO DIMENSIONAL FLOWS
Two-Dimensional flows – Use of cylindrical polar co-ordinates – Stream function, complex potential for two-dimensional flows, irrotational, incompressible flow – Complex potential for standard two dimensional flows – Two dimensional image systems – Milne-Thomson circle theorem – Theorem of Blasius.

UNIT IV CONFORMAL TRANSFORMATION AND ITS APPLICATIONS
Use of conformal transformations – Hydrodynamical aspects of conformal mapping - Schwarz Christoffel transformation – Vortex rows.

UNIT V VISCOUS FLOWS

OUTCOMES
At the end of the course, the students will be able to
- understand the concepts of kinematics and kinetics of fluid mechanics.
- derive the governing equations of fluid flows.
- solve the fluid flows in two-dimensional and axisymmetric geometries.
- apply conformation transformation to fluid flows.
- solve the viscous fluid flow problems in different geometries.

REFERENCES

MT5014 FORMAL LANGUAGES AND AUTOMATA THEORY

OBJECTIVES
- To introduce finite state automata as language acceptor of regular sets.
- To introduce context free grammars and context free languages and their normal forms.
- To explain pushdown automata as the language acceptor of context-free language.
- To demonstrate Turing machine as a mathematical model of language acceptor of recursively enumerable language and computer of computing number theoretic functions.
- To explain the Chomsky hierarchy among the formal languages.

UNIT I REGULAR SETS AND FINITE STATE AUTOMATA
Finite state automata – Deterministic and non-deterministic model - Languages accepted by Finite State Automata - Regular Expression - Pumping Lemma for regular set.

UNIT II CONTEXT FREE LANGUAGES
Grammar - Context Free Grammars - Derivation trees - Simplification of context - Free grammar (only Construction and no proof of equivalence of grammars) - Chomsky normal Form - Greibach Normal Form.
UNIT III  PUSH DOWN AUTOMATA AND PROPERTIES OF CONTEXT FREE LANGUAGES  9
Pushdown automata - Push down automata and Context free languages - Pumping lemma for context free languages.

UNIT IV  TURING MACHINE AND UNDECIDABILITY  9
Turing Machine model - Computational languages and functions - Modifications of Turing machines (only description, no proof for theorems on equivalence of the modification) - Problems - Properties of recursive and recursively enumerable languages - Universal Turing Machine and the undecidable problem.

UNIT V  THE CHOMSKY HIERARCHY  9
Regular grammar - Unrestricted grammar - Context Sensitive languages - Linear bounded automata - Relation between classes of languages.

OUTCOMES
At the end of the course, students will be able to
- Design finite state automata to accept regular sets.
- Form context free grammar to generate context free language and able to obtain its normal form.
- Design pushdown automata to accept a context free language.
- Design Turing machine to accept recursive enumerable language, to compute number theoretic functions and able to understand the limitation of Turing computing model.
- Understand overall set theoretical relationship of formal languages.

REFERENCES

MT5015 FUNCTIONAL ANALYSIS AND ITS APPLICATIONS TO PARTIAL DIFFERENTIAL EQUATIONS L T P C 3 0 0 3
(Prerequisite: Functional Analysis and Partial Differential Equations)

OBJECTIVES
- The aim of the course is to make the students understand the functional analysis concepts and techniques used in partial differential equations.
- To introduce Sobolev Spaces and their properties.
- To find weak solutions to elliptic boundary value problems.
- To introduce finite element method and the analysis of the method.
- To introduce semigroups in Hilbert spaces.

UNIT I  DISTRIBUTION THEORY  9
Distributions - operations with distributions - support and singular support – convolutions - fundamental solutions.

UNIT II  SOBOLEV SPACES  9
Basic properties - approximation by smooth functions and consequences - imbedding theorems - Rellich-Kondrasov compactness theorems - trace spaces - dual spaces - trace theory.
UNIT III WEAK SOLUTIONS OF ELLIPTIC EQUATIONS
Abstract variational results (Lax-Milgram lemma, Babuska-Brezzi theorem) - existence and uniqueness of weak solutions for elliptic boundary value problems (Dirichlet, Neumann problems) - regularity results.

UNIT IV GALERKIN METHODS
Galerkin method - maximum principles - eigenvalue problems - introduction to the mathematical theory of the finite element method.

UNIT V EVOLUTION EQUATIONS
Unbounded operators - exponential map - C0-semigroups - Hille-Yosida theorem - contraction semigroups in Hilbert spaces - applications to the heat wave.

TOTAL: 45 PERIODS

OUTCOMES
- The course, apart from providing a thorough understanding of the functional analytic concepts and techniques used in partial differential equations, will enable them to solve the partial differential equations of various problems arising in Science and Engineering.
- The student will gain more understanding of Sobolev spaces, trace spaces etc.
- The student will be able to solve various elliptic boundary value problems.
- The student will be able to find solutions to partial differential equations through Galerkin’s finite element method.
- The student will be in a position to apply the technique to the heat wave problem.

REFERENCES

MT5016 FUZZY SET THEORY

OBJECTIVES
- To define the basic ideas and entities in fuzzy set theory.
- To introduce the various types of operations on fuzzy sets.
- To extend the idea of operations on fuzzy sets to fuzzy numbers.
- To discuss the concepts and properties of relations on fuzzy sets.
- To learn how to obtain a fuzzy relation equation and its solution procedure.

UNIT I FUZZY SETS VARSUS CRISP SETS
Fuzzy sets - Basic types - Fuzzy sets - Basic concepts - Additional properties of Alpha-cuts - Representations of fuzzy sets - Extension principle for fuzzy sets.

UNIT II OPERATIONS ON FUZZY SETS
Types of operations - Fuzzy complements - Fuzzy intersections: t-norms - Fuzzy unions: t-co-norms - Combinations of operations.

UNIT III FUZZY ARITHMETIC
Fuzzy numbers - Linguistic variables - Arithmetic operations on Intervals - Arithmetic operations on fuzzy numbers.

UNIT IV FUZZY RELATIONS
Crisp and fuzzy relations - Projections and cylindric extensions - Binary fuzzy relations - Binary relations on a single set - Fuzzy equivalence relations - Fuzzy compatibility relations - Fuzzy ordering relations - Sup-i composition and inf-wi compositions of Fuzzy relations.
UNIT V  FUZZY RELATION EQUATIONS  9
Partition - Solution method - Fuzzy relation equations based on sup-i compositions and inf-wi compositions.

OUTCOMES
- It helps to understand the basics of fuzzy sets and its properties.
- It gives a clear idea of various types of operations on fuzzy sets.
- It extends the essence of operations on fuzzy sets to fuzzy numbers.
- It paves way to define the concepts and properties of relations on fuzzy sets.
- It helps to obtain the fuzzy relation equation and its solution procedure.

REFERENCES

MT5017  GEOMETRIC FUNCTION THEORY  L T P C
3 0 0 3
(Prerequisite: Complex Analysis)

OBJECTIVES
- The advanced level of Complex Analysis has been introduced and an expertise treatment is provided on Subordination, General Extremal problems and Integral transforms.
- To introduce primitive variational method.
- To introduce the concept of subordination.
- To introduce extremal problems and properties.
- To introduce the coefficient conjecture.

UNIT I  ELEMENTARY THEORY OF UNIVALENT FUNCTIONS  9
Area theorem - Growth and distortion theorems - Coefficient estimates - Convex and Starlike functions - Close to convex functions – Spiral-like functions - Typically real functions.

UNIT II  VARIATIONAL METHODS  9

UNIT III  SUBORDINATION  9
Basic principles - Coefficient inequalities - Sharpened forms of the Schwartz lemma - Majorization - Univalent subordinate functions.

UNIT IV  GENERAL EXTREMAL PROBLEMS  9
Functionals of linear spaces - Representation of linear functionals - Extreme points and support points- Properties of extremal functions – Extreme points of S, Extreme points of \( \Sigma \).

UNIT V  COEFFICIENT CONJECTURE  9
Preliminaries – Proof of the Coefficient Conjecture.

TOTAL: 45 PERIODS
OUTCOMES
- The course equips the students with theory of Univalent functions and related mathematical concepts based on the same.
- The students will have a thorough understanding of univalent functions.
- The students will gain knowledge in subordination and univalent subordinate functions.
- The students will get an understanding in solving extremal problems.
- The students will get introduced to the concept of coefficient conjecture.

REFERENCES

MT5018 GRAPH THEORY

OBJECTIVES
- To introduce graph models and their basic concepts.
- To explain the importance of connectivity and traversability in graphs.
- To provide structural characterization of graphs with matching and perfect matching.
- To give exposure to graph coloring
- To give structural understanding of planar graphs.

UNIT I INTRODUCTION
Graphs and simple graphs - Graph isomorphism - Incidence and adjacency matrices - subgraphs - Vertex degrees - Paths and connection - Cycles - Trees - Cut edges and bonds - Cut vertices - The Shortest Path Problem - The Connector Problem.

UNIT II CONNECTIVITY AND TRAVERSIBILITY
Connectivity - Whitney’s theorems - Blocks - Applications of connectivity - Euler’s tour - Hamilton Cycles - The Chinese Postman Problem - The Traveling Salesman Problem (only a brief introduction on these problems.)

UNIT III MATCHING
Matching - Matchings and covering in bipartite graphs - Perfect matchings - Independent sets.

UNIT IV COLORING
Vertex chromatic number - k-critical graphs - Brook’s theorem - Chromatic polynomials - Girth and Chromatic number.

UNIT V PLANAR GRAPHS
Planar graphs - Euler’s formula - Kurtofski’s theorem - Five color theorem.

TOTAL : 45 PERIODS

OUTCOMES
At the end of the course, students will be able to
- Understand the graph models and their utilities and relevant basic concepts.
- Use graph traversability in solving application problems.
- Apply graph matching ideas in various matching related problems.
- Apply graph coloring ideas in solving graph partitioning related problems.
- Apply graph planarity ideas in solving application problems

REFERENCES
OBJECTIVES

- To introduce the notion of homotopy
- To introduce the notion of the fundamental group of a space and to see some applications
- To introduce Van Kampen’s theorem and see some simple applications
- To introduce covering spaces and to understand the connection between covering spaces and the fundamental group of the base space of a covering space
- To learn about the classification of covering spaces

UNIT I: HOMOTOPY
Homotopy and Homotopy type, contractible spaces, retraction and deformation, Homotopy extension property.

UNIT II: THE FUNDAMENTAL GROUP
Fundamental groups, the Fundamental group of the circle, applications - Brouwer fixed point theorem in dimension 2.

UNIT III: VAN KAMPEN THEOREM
Free product of groups, Van Kampen theorem, simple applications.

UNIT IV: COVERING SPACES
Covering projections, Homotopy lifting property, relations with fundamental group.

UNIT V: MORE ON COVERING SPACES
The classification of covering spaces, covering transformations.

TOTAL: 45 PERIODS

OUTCOMES

- The students would have learnt about homotopy between maps and homotopically equivalent spaces
- Students would have learnt about fundamental groups and simple applications like the Brouwer fixed point theorem in dimension 2
- Students will be able to compute fundamental groups of spaces using Van Kampen’s theorem
- Students would have understood in detail about covering spaces
- The students will have an understanding of covering transformations and regular coverings

REFERENCES

UNIT I  LIE ALGEBRAS  9
The notion of a Lie algebra, Linear Lie algebras, Lie algebras of derivations.

UNIT II  IDEALS AND HOMOMORPHISMS  9
Ideals, homomorphisms and representations, automorphisms.

UNIT III  SOLVABLE AND NILPOTENT LIE ALGEBRAS  9
Solvability, nilpotency, Engel's theorem, Lie's theorem, Cartan's criterion.

UNIT IV  SEMISIMPLE LIE ALGEBRAS  11

UNIT V  REPRESENTATIONS OF sl(2,F)  7
Weights and maximal vectors, classification of irreducible modules.

TOTAL: 45 PERIODS

OUTCOMES
- Students would have learnt the basic axioms defining a Lie algebra
- Students will be knowledgeable about ideals, homomorphisms and the representations of a Lie algebra
- Students would have learnt about solvable and nilpotent Lie algebras in detail
- Students will have a good understanding of semi-simple Lie algebras
- Student would have a thorough understanding of the irreducible representations of sl(2,F)

REFERENCES

MT5021  MATHEMATICAL ASPECTS OF FINITE ELEMENT METHOD  L T P C
3 0 0 3

(Prerequisite: Functional Analysis)

OBJECTIVES
- The aim of the course is to make the students understand the mathematical aspects of finite element method required for solving partial differential equations.
- To introduce Sobolev Spaces and their properties.
- To introduce the concept of variational formulation of elliptic and parabolic boundary value problems.
- To introduce various element methods.
- To introduce higher dimensional variational problems.

UNIT I  BASIC CONCEPTS  9
Weak formulation of Boundary value problems - Ritz-Galerkin approximation - Error estimates - Piecewise polynomial spaces - Finite Element Method - Relationship to difference.

UNIT II  SOBOLEV SPACES  9
Review of Lebesgue integration theory - Weak derivatives - Sobolev norms and associated spaces - Inclusion relations and Sobolev’s inequality - Trace theorems.

UNIT III  VARIATIONAL FORMULATIONS  9
UNIT IV CONSTRUCTION OF FINITE ELEMENT SPACE AND APPROXIMATION THEORY IN SOBOLEV SPACES


UNIT V HIGHER DIMENSIONAL VARIATIONAL PROBLEMS


OUTCOMES

- The students will be in position to tackle complex problems involving partial differential equations arising in the mathematical models of various problems in Science and Engineering by finite element techniques.
- The student will gain more understanding of Sobolev spaces.
- The student will have more knowledge about variational formulations of elliptic and parabolic boundary value problems.
- The student will get to know about different element methods and be able to find error estimates for different methods.
- The student will be able to extend the knowledge to higher dimensional variational problems.

REFERENCES


MT5022 MATHEMATICAL FINANCE

OBJECTIVES

- To understand the basic probability concepts in association with random variables and significance of the Central Limit theorem with respect to the Brownian motion.
- To understand the basic concepts of present value and accumulated value and apply these concepts toward solving more complicated financial problems and complex annuity problems.
- To appreciate the Arbitrage theorem in the context of the Black – Scholes formula.
- To obtain a practical knowledge on the Portfolio selection problem
- To understand option pricing with respect to various options via multi-period binomial models.

UNIT I PROBABILITY AND RANDOM VARIABLES


UNIT II PRESENT VALUE ANALYSIS AND ARBITRAGE

Interest rates - Present value analysis - Rate of return - Continuously varying interest rates - Pricing contracts via Arbitrage - An example in options pricing.
UNIT III ARBITRAGE THEOREM AND BLACK-SCHOLES FORMULA

UNIT IV EXPECTED UTILITY
Limitations of arbitrage pricing - Valuing investments by expected utility - The portfolio section problem - Capital assets pricing model - Rates of return - Single period and geometric Brownian motion.

UNIT V EXOTIC OPTIONS

TOTAL: 45 PERIODS

OUTCOMES
• To demonstrate a comprehensive understanding of the probability concepts
• To locate and use information to solve problems in interest theory and financial engineering
• To know the main features of models commonly drawn from industry and financial firms in order to explore arbitrage strategy
• To understand and appraise utility and effectiveness in option pricing
• To simulate appropriate models treating Exotic options

REFERENCES

MT5023 MATHEMATICAL PROGRAMMING

OBJECTIVE
• To provide knowledge and training using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR PROGRAMMING

UNIT II ADVANCED LINEAR PROGRAMMING
Duality - Dual simplex method - Revised simplex method - Bounded variable technique.

UNIT III INTEGER PROGRAMMING
Cutting plane algorithm - Branch and bound technique - Applications of Integer programming.

UNIT IV NON-LINEAR PROGRAMMING
Unconstrained one variable and multi variable optimization, KKT Conditions, Constrained optimization, Quadratic programming, Convex programming, Separable programming, Geometric programming, Non-Convex programming.

UNIT V DYNAMIC PROGRAMMING
Principle of optimality - Forward and backward recursive equations - Deterministic dynamic programming applications.

TOTAL: 45 PERIODS
OUTCOMES

- Prepares the student to model various real life situations as Optimization problems and effect their solution through Mathematical Programming techniques
- Students will gain familiarity with some of the well-known optimization techniques and their applicability in a real setting
- Students will gain awareness on the usefulness and limitations of optimization
- An ability to use visualization and optimization tools to expose ideas and solutions

REFERENCES


MT5024 MATHEMATICAL STATISTICS

OBJECTIVES

- To understand the basic concepts of sampling distributions and statistical properties of point and interval estimators.
- To apply the small/ large sample tests through Tests of hypothesis
- To understand the correlation and regression concepts in empirical statistics
- To understand the concept of analysis of variance and use them to investigate factorial dependence
- To appreciate the classical multivariate methods and computational techniques.

UNIT I SAMPLING DISTRIBUTIONS AND ESTIMATION THEORY

Sampling distributions - Characteristics of good estimators - Method of Moments - Maximum Likelihood Estimation - Interval estimates for mean, variance and proportions.

UNIT II TESTING OF HYPOTHESIS

Type I and Type II errors - Tests based on Normal, t, \( \chi^2 \) and F distributions for testing of mean, variance and proportions - Tests for Independence of attributes and Goodness of fit.

UNIT III CORRELATION AND REGRESSION

Method of Least Squares - Linear Regression - Normal Regression Analysis - Normal Correlation Analysis - Partial and Multiple Correlation - Multiple Linear Regression.

UNIT IV DESIGN OF EXPERIMENTS

Analysis of Variance - One-way and two-way Classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design.

UNIT V MULTIVARIATE ANALYSIS

Mean Vector and Covariance Matrices - Partitioning of Covariance Matrices - Combination of Random Variables for Mean Vector and Covariance Matrix - Multivariate, Normal Density and its Properties - Principal Components: Population principal components - Principal components from standardized variables.

TOTAL: 45 PERIODS
OUTCOMES
On successful completion of this course students will be able to:

- Demonstrate knowledge of, and properties of, statistical models in common use
- Apply the basic principles underlying statistical inference (estimation and hypothesis testing)
- Be able to construct tests and estimators, and derive their properties
- Demonstrate knowledge of applicable large sample theory of estimators and tests.
- Recognize the importance of Multivariate analysis in various practical application

REFERENCES

MT5025 NETWORKS, GAMES AND DECISIONS
L T P C 3 0 0 3

OBJECTIVES
- To introduce the certain algorithms for solving the network models
- To expose them to different project management techniques like PERT and CPM
- To familiarize with the various aspects of game theory which involves decision situation in which two intelligent opponents with conflicting objectives are vying to outdo one another
- To introduce the students to the idea of making decision for problems involving various alternatives
- To get an idea of certain topics on random processes such as Weiner porcess and OU process.

UNIT I NETWORK MODELS
Scope and definition of network models - Minimal spanning tree algorithm - Shortest - route problem - Maximal-flow Model.

UNIT II CPM AND PERT
Network representation - Critical path (CPM) computations - Construction of the time schedule - Linear programming formulation of CPM - PERT calculations.

UNIT III GAME THEORY
Optimal solution of two-person zero-sum games - Mixed strategies - Graphical solution of (2 x n) and (m x 2) games - Solution of m x n games by linear programming.

UNIT IV DECISION ANALYSIS
Decision making under certainty: analytic hierarchy process (AHP) - Decision making under risk - Decision under uncertainty.

UNIT V MARKOVIAN DECISION PROCESS
Scope of the Markovian decision problem - Finite stage dynamic programming model - Infinite stage model - Linear programming solution.

OUTCOMES
- It helps in formulating many practical problems in the frame work of Networks.
- It helps the students understand that CPM is a deterministic method whereas PERT uses a probabilistic model which deals with unpredictable activities.
• It enables the students to identify competitive situations which can be modeled and solved by game theoretic formulations.
• It molds the students to make decisions for various real-time problems subject to uncertainty and risk.
• It offers interesting techniques to quantify and effectively obtain the solution of various decision-making situations.

REFERENCES

MT5026 NUMBER THEORY

OBJECTIVES
• To introduce the concept of divisibility
• To introduce congruences and the Chinese Remainder Theorem
• To introduce what is a public-key cryptography and the use of primitive roots, power residues and quadratic residues
• To introduce some functions of number theory like greatest integer function, arithmetic functions and Mobius inversion formula
• To introduce Diophantine equations and Farey Fractions

UNIT I DIVISIBILITY
Introduction - Divisibility - Primes - The binomial theorem.

UNIT II CONGRUENCES
Congruences - Solutions of congruences - The Chinese Remainder Theorem - Techniques of numerical calculation.

UNIT III APPLICATION OF CONGRUENCE AND QUADRATIC RECIPROCITY
Public - Key cryptography - Prime power moduli - Prime modulus - Primitive roots and power residues - Quadratic residues - The Gaussian reciprocity law.

UNIT IV FUNCTIONS OF NUMBER THEORY
Greatest integer function - Arithmetic functions - Mobius inversion formula - Recurrence functions - Combinational number theory.

UNIT V DIOPHANTINE EQUATIONS AND FAREY FRACTIONS
The equations ax + by = c Pythagorean triangle - Shortest examples - Farey sequences - Rational approximations.

TOTAL: 45 PERIODS

OUTCOMES
• The student would have learnt to solve divisibility problems using the binomial theorem.
• Students would have learnt some techniques of numerical calculations using congruences.
• Students will be able to apply the Gaussian reciprocity law in public-key cryptography.
• Students will have a good foundation in combinatorial number theory.
• The students will be able to solve some Diophantine equations and some special cases of Fermat’s Last theorem.
REFERENCES

MT5027 NUMBER THEORY AND CRYPTOGRAPHY L T P C

3 0 0 3

OBJECTIVES:
• To introduce the mathematics needed in cryptography, like time estimation for doing mathematical operations
• To introduce more advanced topics like finite fields and multiplicative generators
• Students will be introduced to crypto systems
• To introduce pseudo primes and simple tests for primality
• To introduce elliptic curves and advanced primality tests

UNIT I INTRODUCTION TO NUMBER THEORY
Time estimates for doing arithmetic - Divisibility and the Euclidean algorithm - Congruences - Modular exponentiation - Some applications to factoring.

UNIT II QUADRATICS RESIDUES AND RECIPROCITY
Finite Fields - Multiplicative generators - Quadratic residues and reciprocity.

UNIT III CRYPTOSYSTEMS

UNIT IV PRIMALITY AND FACTORING - I

UNIT V PRIMALITY AND FACTORING – II
Elliptic Curves - Elliptic Curve Cryptosystems - Elliptic curve primality test - Elliptic Curve factoring - Pollard’s p - 1 method - Elliptic curve reduction modulo n.

TOTAL: 45 PERIODS

OUTCOMES
• The students would have learnt to assess and improve computer algorithms required for public key cryptography.
• Students would be able to apply quadratic reciprocity law in number theory and cryptography
• The students will know about different types of crypto systems and will be able to compute discrete log
• Students will be able to apply Solovay-Strassen Primality test, Miller - Rabin test and Rho method.
• Students will be able to deal with elliptic curve cryptosystems and would have learnt some advanced factoring methods

REFERENCES
MT5028 NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS  L T P C 3 0 0 3

(Prerequisite: Numerical Analysis and Partial Differential Equations)

OBJECTIVES

• To make the students understand the numerical methods of solving partial differential equations.
• To introduce the methods of solving one-dimensional parabolic equations.
• To demonstrate the methods of solving two-dimensional parabolic equations.
• To display the methods of solving hyperbolic equations.
• To reveal the ideas of solving elliptic equations.

UNIT I LINEAR SYSTEMS OF EQUATIONS


UNIT II ONE DIMENSIONAL PARABOLIC EQUATIONS

Explicit and Crank-Nicolson Schemes for $u_t = u_{xx}$ - Weighted average approximation – Derivative boundary conditions - Truncation errors - Consistency, Stability and convergence - Lax Equivalence theorem.

UNIT III MATRIX NORMS & TWO DIMENSIONAL PARABOLIC EQUATION


UNIT IV HYPERBOLIC EQUATIONS

First order quasi-linear equations and characteristics - Numerical integration along a characteristic - Lax-Wendroff explicit method - Second order quasi-linear hyperbolic equation - Characteristics - Solution by the method of characteristics.

UNIT V ELLIPTIC EQUATIONS

Solution of Laplace and Poisson equations in a rectangular region - Finite difference in Polar coordinate Formulas for derivatives near a curved boundary when using a square mesh - Discretisation error - Mixed Boundary value problems.

TOTAL: 45 PERIODS

OUTCOMES

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

• learn various numerical methods of solving partial differential equations.
• solve one-dimensional parabolic equations using explicit and implicit schemes.
• solve two-dimensional parabolic equations and analyze the stability of the schemes.
• understand the methods of solving hyperbolic equations.
• solve elliptic equations in Cartesian and Polar coordinates.

REFERENCES

MT5029  QUEUEING AND RELIABILITY MODELLING  L T P C  3 0 0 3

OBJECTIVES:
- To introduce the basic concept of Markovian queueing systems.
- To analyze the advance Markovian queues such as bulk input, batch service and priority queues.
- To familiarize the non-Markov queues and their performance measures.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

UNIT I  MARKOVIAN QUEUES  9
Steady State Analysis - Single and multiple channel queues - Erlang’s formula - Queues with unlimited waiting space - Finite source queues.

UNIT II  ADVANCED MARKOVIAN QUEUES  9
Bulk input model - Bulk service model - Erlangian models - Priority queue discipline.

UNIT III  NON-MARKOVIAN QUEUES  9
M/G/1 queueing model - Pollaczek-Khintchine formula - Steady-state system size probabilities - Waiting time distributions - Generalization of Little’s formula - Busy period analysis of M/G/1 queue.

UNIT IV  SYSTEM RELIABILITY  9
Reliability and hazard functions - Exponential, normal, weibull and Gamma failure distributions - Time-dependent hazard models, Reliability of series and parallel systems.

UNIT V  MAINTAINABILITY AND AVAILABILITY  9
Maintainability and Availability functions - Frequency of failures - Two unit parallel system with repair - k out of m systems.

TOTAL : 45 PERIODS

OUTCOMES
- The students are equipped to evaluate the various system performance measures for basic queueing systems.
- Implementation of mathematical techniques to study the priority and non-priority queues.
- Students will able to formulate the various kinds of Non-Markovian queueing models.
- Students can analyze reliability of the systems for various probability distributions.
- Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

REFERENCES
OBJECTIVES

- To understand the basic concepts of stochastic processes and be able to develop and analyse the stochastic models that capture the significant features of the probability models in order to predict the short and long term effects in the system.
- To Learn and model the renewal processes and study its theorems and their behavior.
- To study about the combination of renewal processes and Markov process.
- To understand the concept of branching processes and its nature. Also, to learn the variety of models in branching process.
- To find the nature of Wiener process and study its properties.

UNIT I  MARKOV AND STATIONARY PROCESSES  9

UNIT II  RENEWAL PROCESSES  9
Renewal processes in continuous time - Renewal equation - Stopping time Wald’s equation - Renewal theorems - Delayed and Equilibrium renewal processes - Residual and excess life times - Renewal reward process - Alternating renewal process.

UNIT III  MARKOV RENEWAL AND SEMI – MARKOV PROCESSES  9
Definition and preliminary results - Markov renewal equation - Limiting behaviour - First passage time.

UNIT IV  BRANCHING PROCESSES  9
Generating functions of branching processes - Probability of extinction - Distribution of the total number of progeny - Generalization of classical Galton - Watson process - Continuous time Markov branching process - Age dependent branching process.

UNIT V  MARKOV PROCESSES WITH CONTINUOUS STATE SPACE  9

OUTCOMES
After the completion of the course, the students will be able to

- Understand and characterize the random phenomena and model a stochastic system.
- Connect the real life situation and renewal processes.
- Obtain the knowledge about the advanced studies of renewal processes.
- Understand stochastic population models through branching processes.
- Obtain the knowledge about Wiener processes

REFERENCES
OBJECTIVES

- To introduce the elasticity concepts of strain and stress.
- To enable the students to derive the governing equations of equilibrium and those of motion.
- To introduce the theory of linear elastic homogeneous isotropic materials.
- To make the students understand the torsion experiment in various geometries.
- To demonstrate the two and three dimensional problems in elasticity.

UNIT I  ANALYSIS OF STRAIN

Deformation - Strain tensor in rectangular Cartesian coordinates - Geometric interpretation of infinitesimal strain - Rotation - compatibility of strain components - Properties of strain tensor - Strain in spherical and cylindrical polar coordinates.

UNIT II  ANALYSIS OF STRESS


UNIT III  LINEAR THEORY OF ELASTICITY

Generalized Hooke’s law - Stress-Strain relationship for an isotropic elastic material, Basic equation of elasticity for homogeneous isotropic bodies - Boundary value problems - The problem of equilibrium and the uniqueness of solution of elasticity - Saint-Venant’s principle.

UNIT IV  TORSION

Torsion of prismatic bars - Torsion of circular - Elliptic and rectangular bars - Membrane analogy - Torsion of rectangular section and hollow thin walled sections.

UNIT V  SOLUTION OF TWO AND THREE DIMENSIONAL PROBLEMS IN ELASTICITY

Bending of a cantilever beam - Simply supported beam with simple loadings - Semi-infinite medium subjected to simple loadings - Plane elastic waves - Rayleigh surface waves - Love waves - Vibration of an infinite isotropic solid cylinder.

OUTCOMES

At the end of the course, the students will be able to
- understand the elasticity concepts of strain and stress
- derive the equations of equilibrium and those of motion
- derive the constitutive equation of linear elastic homogeneous isotropic materials
- perform the torsion experiment in various geometries
- solve two and three dimensional problems in elasticity.

REFERENCES

OBJECTIVES

- To revise Fourier analysis and continuous time convolution.
- To introduce the notions of wavelet transforms, Time frequency analysis.
- To introduce multi-resolution analysis and wavelets.
- Also to introduce the more specialized topics like compactly supported wavelets.
- To introduce cardinal splines and spline wavelets.

UNIT I

FOURIER ANALYSIS

Fourier and inverse Fourier transforms - Continuous time convolution and the delta function - Fourier transform of square integrable functions - Poisson's summation formula.

UNIT II

WAVELET TRANSFORMS AND TIME-FREQUENCY ANALYSIS

The Gabor transform - Short time Fourier transforms and the uncertainty principle - The integral wavelet transform - Diadic Wavelets and inversions - Frames.

UNIT III

MULTI RESOLUTION ANALYSIS AND WAVELETS

The Haar wavelet construction - Multi resolution analysis - Riesz basis to orthonormal basis - Sealing function and scaling identity - Construction of wavelet basis.

UNIT IV

COMPactly SUPPORTED WAVELETS

Vanishing moment's property - Meyer's wavelets - Construction of a compactly supported wavelet - Smooth wavelets.

UNIT V

CARDINAL SPLINES AND SPLINE WAVELETS

Cardinal spline spaces - B-splines - computation of cardinal splines - spline wavelets - Exponential decay of spline wavelets.

TOTAL: 45 PERIODS

OUTCOMES

- The students will be able to thoroughly handle Fourier analysis.
- Students would be trained to handle “Wavelets”, which is a versatile tool with rich mathematical content and has great potential for applications in engineering.
- The student will be equipped for constructing wavelets.
- The student will be able to construct compactly supported wavelets.
- The student will get introduced to spline wavelets and their properties.

REFERENCES


OPEN ELECTIVE COURSES (OEC)

MP5491

NUCLEAR ENERGY IN HEALTH CARE AND INDUSTRY

OBJECTIVES

- To provide the student about the action of radiation on living cells and the response.
- To make the student to understand the basic nuclear medicine physics and newer technology systems.
- To enable the students to understand the diagnostic and therapeutic nuclear medicine techniques.
- To provide a broad knowledge in radiation hazard evaluation and control
UNIT I  BASICS OF NUCLEAR SCIENCE AND RADIATION EFFECTS  9
Radioactivity, nuclear reactions and interaction of ionizing radiation with matter, with emphasis on radiation detection, radiation shielding - photoelectric - Compton effect and pair production - biological effects on human health - Action of radiation on living cells - direct and indirect physical damage - cell response to radiation - somatic and genetic radiation effects - Radiation side effects - Acute and chronic effects of low dose effects.

UNIT II  DIAGNOSTIC APPLICATIONS OF NUCLEAR ENERGY  9
Production of X rays and its applications X-ray radiography - CT scan - contrast studies in x ray imaging - fluoroscopic applications - Mammography - physics of nuclear medicine and nuclear imaging - radio isotopes in diagnosis of nuclear imaging - Tc-99m extraction - radiopharmaceuticals - scanning instruments and techniques.

UNIT III  THERAPEUTIC APPLICATION OF NUCLEAR ENERGY  9
Production of nuclear radiations - alpha, beta and gamma rays and X-rays - External radiation therapy - telecobalt unit and linear accelerators - and internal radiation therapy - Iridium -192 HDR brachtherapy unit - therapeutic nuclear medicine.

UNIT IV  INDUSTRIAL APPLICATIONS OF NUCLEAR ENERGY  9
Industrial applications — Non destructive testing - industrial radiography - tracing, gauging, Radiation sterilization of medical equipments - food preservation and other applications.

UNIT V  NUCLEAR RADIATION SAFETY MEASURES  9
Basic concepts of radiation protection standards - ICRP recommendations - systems of radiological protection - Optimization of protection and individual dos limits - Radiation dose to individuals from natural radioactivity in the environment and man-made sources - Evaluation of external and internal radiation hazards - effect of time, distance and shielding - radioactive waste disposal and transport of radioactive nuclides.

TOTAL: 45 PERIODS

OUTCOMES
After successful completion of the course
- students will be able to handle radioactive source carefully for treatment purpose.
- will develop competence in radioactive waste disposal management
- Will be develop competency to face radiation emergency
- students will develop critical thinking skills in radiation safety and protection.
- will be able to safe guard the radioactive sources used in hospitals.

REFERENCE BOOKS:

MP5492 SMART MATERIALS FOR ENERGY AND ENVIRONMENT APPLCATIONS

OBJECTIVES
- To provide fundamental understanding on smart and intelligent materials.
- To enhance students’ understanding on the structure-property relationship.
- To enable students appreciate novel materials and their usage in current cutting edge technologies.
UNIT I  BASICS OF SMART MATERIALS AND STRUCTURES  9

UNIT II  INTELLIGENT MATERIALS FOR ENERGY GENERATION  9
Artificial Intelligence in Materials, Ferroelectricity: Introduction - Piezoelectric effect, Piezoelectric materials as sensors, Actuators and bimorphs - Transparent Conducting Materials – Band-gap and electrical conductivity, Conditions for transparency – role of defects on conductivity - Applications: Solar cells, Touch screen, etc.

UNIT III  SHAPE MEMORY MATERIALS FOR ENERGY STORAGE  9
Introduction to structure types, Structure-property relationships, Shape memory effect (SME), One way and two-way SME, Shape memory alloys (SMAs), Intelligence in the form of SMA, Functional properties of SMAs. Thermal-storage, and aerospace applications. Shape-memory polymers, and their applications.

UNIT IV  MULTIFERROIC MATERIALS FOR NOVEL REFRIGERATION  9

UNIT V  INTELLIGENT OPTICAL MATERIALS FOR ENVIRONMENT  9

TOTAL: 45 PERIODS

OUTCOMES
• The student will understand the working principle of smart materials
• The student will get an overview on various types of smart materials and their application areas.
• The student will get ideas to use smart materials in green energy and environment applications
• The student will get motivated to find novel applications of these multifunctional materials in new technologies.
• The student will get an idea on different synthesis and characterization techniques

REFERENCES

EA5491  CLIMATE JOURNALISM  L T P C
3 0 0 3

OBJECTIVES
• To offer a comprehensive approach to reporting of climate change.
• To impart knowledge about political, economic, and ethical questions raised by the need for transformative change of societies in the wake of climate change.
• To reflect over the development of climate change as a nature and a society issue.
• To synthesize knowledge from different areas related to climate change.
• To reflect on the norms and values of journalism in the context of climate change.
UNIT I  HUMAN INFLUENCES
Anthropocene Era (anthropo: man, and cene: new) - Freshwater scarcity - The decline of our oceans, fish, and wildlife - Environmental health - Sustainable energy, agriculture, and food systems – Role and responsibility of journalists – Making climate change relevant as a society issue – Politics and economics of climate change – Environmental ethics – Human health – Species migration.

UNIT II  PUBLIC NARRATIVES
Complex science and uncertainty - Public apathy and politics - Well-funded counter-narratives - Zealous stakeholders - What can (incorrectly) appear due to a lack of news hook for stories - Two centuries of CO₂ emissions.

UNIT III  JOURNALISTIC CHALLENGES
Environmental Journalism as a craft - Roles and differences between journalism and communications – Finding the most accurate, credible and timeliest information on science and issues – Essentials of environmental reporting – Discerning uncompromised expert sources – Using human narratives and descriptive storytelling to relate real-world impact – Tapping the databases, records and other tools commonly used by environmental reporters.

UNIT IV  CLIMATE ISSUES
The lack of diversity in environmental journalism – “Junk science” – Battling climate denial - Covering GMOs – The problem of doomsday climate reporting – Digital security for journalists and researchers etc.

UNIT V  JOURNALISTIC SKILLS
Hands-on journalistic series – Reporting, developing, funding, crafting and publishing environmental stories – Writing diverse stories on environmental history, a wildlife or ocean story, a clam-aquaculture story, a work of nature writing, etc. – A polished, fact-checked, final story with questions answered and edits made from the first draft and at least two added elements such as photos, audio or video clips, graphics, timelines or others to draw people in.

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the importance of climate issues.
- Students will understand the various aspects of climate change and its effect in society.
- Students will learn to cover the climate change issues.
- Students will understand the need of journalistic skills for covering climate issues.
- Students will learn the various strategies, approaches on covering climate issues in various media.

REFERENCES

OBJECTIVES

- To create opportunities for professional and creative expression through the practice and art of photography.
- To inculcate aesthetic sense involved in creativity.
- To get to know the genres of photography

UNIT I  
CAMERA


UNIT II  
LENS AND ELEMENTS OF PHOTOGRAPHY

Different type of Lenses - Basic Shots and Camera Angles, Photographic Composition - View point and Camera angle-Eye Level, Low and High, Balance- Aspects of Balancing, Shapes and Lines, Pattern, Volume, Lighting, Texture, Tone, Contrast- and Colour, Framing, various Perspectives.

UNIT III  
COLOUR AND LIGHTING


UNIT IV  
PEOPLE AND PORTRAIT PHOTOGRAPHY

Indoor and outdoor lighting techniques for portraits, the Casual Portrait, Environmental Portraits, Group Portraits, Familiar Subjects, Hands and Other Details.

UNIT V  
GENRES OF PHOTOGRAPHY

Basic shooting and Lighting Techniques and Equipments required for different genres of Photography like Black and White, Landscape, Cityscape, Architecture, Advertising, Table top photography Fashion, Food, Automobile, Sports, Travel, Children, Portrait, wild life, Still Life, Event, Silhouette, Festival and Themes.

TOTAL: 45 PERIODS

OUTCOMES

- Students will be able to utilize the principles of good composition in photography.
- Students will be able to develop an individual style in representing the society through photographs.
- Students will have a thorough understanding of how to create visual variety
- Students will understand the foundation principles of design
- Students will gain understanding in Depth of field
- Students will understand the different genres of photography

REFERENCES

2. Balakrishna Aiyer, Digital Photojournalism, Authors press, 2005
OBJECTIVES
- To introduce the basic concept and principles of green chemistry for environmental management.
- To make the students know about green reagents and its importance to the environment.
- To acquaint the student with green solvents and its impacts in green chemistry.
- To familiarize the synthesis of materials using green methods.
- To impart the knowledge on applications of green synthesis technology.

UNIT I PRINCIPLES OF GREEN CHEMISTRY
9

UNIT II GREEN REAGENTS AND CATALYSTS
9
Choice of starting materials – reagents (Dimethyl carbonate, polymer supported reagents) – catalysts (microencapsulated Lewis acids, zeolites, basic catalysts polymer supported catalysts, introduction to biocatalysts).

UNIT III GREEN SOLVENTS
9
Aqueous phase reactions (Claisen rearrangement, Aldol condensation, wurtz reaction, reduction of carbon carbon double bond, oxidation of amines into nitro compounds – Electrochemical synthesis (synthesis of adiponitrile) - Ionic liquids – reactions in acidic ionic liquids- reactions in neutral ionic liquids (hydrogenations, diels-Alder reactions, Heck reactions, O-alkylation and N-alkylation, methylene insertion reactions).

UNIT IV GREEN SYNTHESSES
9
Microwave induced green synthesis (Hoffmann Elimination and Oxidation of alcohols) – Ultra sound assisted green synthesis (Esterification, Saponification and Cannizaro reaction) – Solid state green synthesis (Dehydration of alcohols to alkenes, Grignard reaction)- Solid supported organic synthesis (Synthesis of furans and pyrrole).

UNIT V APPLICATIONS OF GREEN SYNTHESIS
9

TOTAL: 45 PERIODS

OUTCOMES
- To be familiar with basic concepts of green chemistry and apply to them in various fields.
- To recognize the catalytic reaction with green reagents and its importance. To identify available green solvents and apply them to various synthesis process.
- To recognize the preparations of materials with green process and its application to the environment.
- To gain the knowledge of preparation of various drugs using green synthesis methods.
- To be have the skills and technology towards green chemistry and apply in industry.

REFERENCES
OBJECTIVES

- To enable the students to acquire knowledge on the macro and micro constituents of the food
- To know the structure and chemical characteristics of constituents of food.
- To demonstrate the knowledge of food chemistry and applying, the principles and concepts of chemistry as they apply to food systems.
- To familiarize the student with the relationship between water and food.
- To explain the rationale for certain food processes and preservation

UNIT I INTRODUCTION TO FOOD AND ITS PROPERTIES 12
Proteins-Enzymes- Chemistry and structure, kinetics, Maillard reaction. Food carbohydrates: Structural, nutritional and functional aspects. Emulsifiers-role of emulsifiers selection of emulsifier based on hydrophilic and Lipophilic balance (HLB) and its application. Thickeners-definition, chemical structure, gel formation, list of permitted thickeners and food application. Chemical and biochemical changes: changes occur in foods during different processing.

UNIT II PROCESSING AND PRESERVATION 12
Scope and benefits of industrial food preservation. Preservation of foods by chemicals, antibodies, antioxidants, salt and sugar. Principles of food freezing: freezing point of foods Psychrometric chart, Freeze concentration, freeze drying, IQF. Nanotechnology: Principles and application in foods, Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

UNIT III FLAVOURS AND COLOURING AGENTS 9
Chemistry of food flavor, definitions, Flavourmatics /flavouring compounds, flavor retention-off flavours and food taints. Colour -Natural and synthetic food colours, their chemical structure, stability, permitted list of colours, usage levels and food application.

UNIT IV WATER RELATIONS IN FOOD 6
Moisture in food: Structure, properties, Types of water in food and their specific function water activity and stability.

UNIT V FOOD ADDITIVES 6
Definitions, uses and functions of: Acids, Bases, Buffer system, chelating/sequestering agents, Antioxidants, Anti-caking agents, Firming agents. Flour bleating agents and Bread improvers. Anti-microbial agents/ class I & II.

TOTAL: 45 PERIODS

OUTCOMES

- Will know about the factors governing the food quality and chemical constituents.
- Will be able to name and describe the general chemical structures of the major components of foods and selected minor components
- Will come to know about the techniques involved in food processing and preservation
- Will be acquainted with food additives and their function in preservation
- Will be familiarize with the nature of packed food from industrial processes

REFERENCES

OBJECTIVES

- To teach characteristics of natural hazards.
- To teach mitigation methods for natural hazards.
- To provide knowledge on assessment and management of natural hazards.

UNIT I  DISASTER PHENOMENON  9
Disaster threat - characteristics-parameters – mapping aspects for earthquake, landslides, tsunami, cyclones, flood, drought and epidemics.

UNIT II  MITIGATION  9

UNIT III  ASSESSMENT  9

UNIT IV  MANAGEMENT  9

UNIT V  CASE STUDIES AND ADVANCED TOOLS  9
Post disaster review – role of remote sensing and GIS –National and state level case studies on various disasters.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course, the students expected to be able to:

- Gain knowledge on natural hazards and their characteristics
- Have better understanding on geological and hydrological hazards
- Appreciate various mitigation techniques.
- Carryout risk assessment and vulnerability mapping
- Understand the role of remote sensing and GIS in natural hazard risk reduction.

REFERENCES


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>
</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>
</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>√</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></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>
</tr>
</tbody>
</table>
OBJECTIVES

- To understand the Sources of Marine Minerals.
- To understand the various energy resources pertain to marine system
- To understand the importance and economic aspects of marine minerals

UNIT I INTRODUCTION


UNIT II OCEAN RESOURCES


UNIT III ENERGY RESOURCES

Wind Energy - Wave Energy - Tidal Energy - Ocean Current Energy - Ocean thermal energy conversion (OTEC) - osmotic power plant-Petroleum resources and radioactive nuclear mineral deposits

UNIT IV OCEAN RESOURCE EXPLORATION AND EXPLOITATION

Marine sampling - Water Samplers - Bottom Samplers - Instrumentation

UNIT V OCEAN MINERAL MINING

Mining aspects of deep-sea polymetallic sulphides - Manganese Nodules - Methane Hydrates. Sand, Sand Mining & Beach replenishment-Marine maps of Exclusive Economic Zone (EEZ)

OUTCOMES

- Students will understand the various sources of marine minerals.
- Students will able to understand the Mineral deposits derived from land sources.
- Students will learn about the energy resources of marine system.
- Students will learn about various sampling methods and instrumentation.
- Students will able to understand the economic aspects of marine minerals.

REFERENCES


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>
</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>
</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>√</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></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>
</tr>
</tbody>
</table>
OBJECTIVES

- To introduce the basics of crystal symmetry and crystal structures.
- To provide students with a background to X-ray generation and detection
- To provide instruction on the steps involved in single crystal structure determination
- To teach the concept of powder X-ray diffraction and its applications
- To teach various crystal growth techniques

UNIT I  CRYSTAL SYMMETRY AND STRUCTURES  9


UNIT II  X-RAYS  9

X-rays - generation of X-rays - sealed tube and rotating anode generators – synchrotron radiation – continuous and characteristic X-rays - X-ray absorption – X-ray monochromators – collimation – Soller slits - X-ray detectors (principles only)

UNIT III  SINGLE CRYSTAL STRUCTURE DETERMINATION  9


UNIT IV  POWDER X-RAY DIFFRACTION  9


UNIT V  CRYSTAL GROWTH TECHNIQUES  9


TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course the students will

- understand crystal symmetry, crystal planes and simple crystal structures
- gain a knowledge of X-ray generation, absorption, monochromatization and detection
- get a working knowledge of single crystal structure determination
- get some insight into the powder diffraction and its applications
- be able to understand the basics of various crystal growth techniques

REFERENCES

MC5492 NONLINEAR SCIENCE L T P C 3 0 0 3

OBJECTIVES
- The students will be introduced to the basics of nonlinear dynamics and its applications.
- The students will learn about the mathematical models needed to study the concepts of fixed points, oscillations, bifurcations and integrability.
- The students will know about the nonlinear dynamical phenomena in chemical systems.
- The students will understand the importance of nonlinear dynamics in biological systems.
- The students will be introduced to the concepts of nonlinear dynamical analysis in geological systems.

UNIT I NONLINEAR DYNAMICS 9

UNIT II MATHEMATICAL MODELS 9
First-order differential equations - separation of variables - slope fields - Euler’s method - equilibria and phase plane - bifurcations - higher-order equations - trace-determinant plane - harmonic oscillators - equilibrium point analysis - non-autonomous systems and chaos - finite dimensional integrable systems - dispersive systems - solitary waves - solitons - analysis of soliton solutions.

UNIT III CHEMICAL SYSTEMS 9

UNIT IV BIOLOGICAL SYSTEMS 9

UNIT V GEOLOGICAL SYSTEMS 9

OUTCOMES
After completing this course, the students should be able to
- Understand the basics of nonlinear dynamics and its applications.
- Gain knowledge on the concepts of fixed points, oscillations, bifurcations and integrability.
- Appreciate the importance of nonlinear dynamical phenomena in chemical systems.
- Understand the role of nonlinear dynamics in biological systems.
- Apply nonlinear dynamical analysis for geological systems.

REFERENCES

MT5491  STATISTICAL METHODS  L T P C  3 0 0 3

OBJECTIVES
- To organize and describe the data and hence compute the various descriptive measures
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions
- To expose to the basic principles of experimental design and hence carry out the analysis of variance
- To use non parametric methods on data sets which are not from normally distributed population
- To prepare the students to implement the various concepts in statistics using R statistical tool

UNIT I  DESCRIPTIVE STATISTICS  9
Frequency distribution - Graphs of frequency distribution - Descriptive Measures - Quartiles and Percentiles - Calculation of sample mean and population mean

UNIT II  HYPOTHESIS TESTING  9
Sampling Distributions - Central Limit Theorem - Testing a Statistical Hypothesis - Tests Concerning Means and variances - Independence of Attributes - Goodness of Fit

UNIT IV  ANALYSIS OF VARIANCES  9
One way and two way classification - Completely Randomized Design - Randomized Block Design - Latin Square Design

UNIT V  NONPARAMETRIC METHODS  9
Sign Test - Wilcoxon's Signed Rank Test - Rank Sum Tests - Tests of Randomness - Kolmogrov Smirnov and Anderson Darling Tests

UNIT V  CALCULATIONS USING R  9

TOTAL: 45 PERIODS

OUTCOMES
- It equips the student to compute mean, variances, quartiles and percentiles for a large set of data points obtained from a series of measurements
- It imparts the knowledge of various test statistics used in hypothesis testing for mean and variances of large and small samples
- It enables the students to compare several means
- It makes the students use sign test and rank test which can be applied to any raw data without the underlying assumptions that the observations are from normal population.
- It equips the students to implement the various concepts learnt using R tool for statistics

REFERENCES
UNIT I  
**Email as a medium of professional communication (1 hour)**

a. Clear, grammatically correct sentences
b. Clear and coherent paragraphs
c. Polite and professional expression
d. Accurate punctuation

**The nature of the e-mail in its present technological state**
a. The pros and cons of using email for professional communication

UNIT II  
**Standard email conventions and etiquette**

a. Conventions for effective emailing intra and inter workplaces (inclusive of formatting)
b. Interpersonal etiquette to be used in professional emailing
c. Cross-cultural dos and don’ts when using email across borders

UNIT III  
**Understanding email messages accurately (2 hours)**

a. Understanding the core message
b. Understanding the writer’s intention and expectation accurately
c. Interpreting the style and tone of the message
d. Reading and understanding messages quickly

UNIT IV  
**Writing clear and contextually appropriate responses (12 hours)**

a. Writing appropriate opening and closing sentences
b. Structuring the email logically and coherently
c. Positioning the core message for reader attention and action
d. Writing messages for a range of professional functions such as giving an update, reporting, requesting, clarifying and confirming, giving instructions etc.

UNIT V  
**Using a range of professional styles (10 hours)**

a. Maintaining courtesy and professional poise in all messages
b. Being direct or indirect as necessary
c. Being elaborate or brief as necessary
d. Being assertive and decisive when needed

**TOTAL: 45 PERIODS**

**Learning outcome:** At the end of the course, the students should

- Understand email as a professional communication medium and as it is used in workplaces today.
- Use standard e-mailing conventions and etiquette used in workplaces internationally.
- Use appropriate style and tone for communicating a variety of professional messages that are generally communicated via e-mail in work and business communication.
- Read and interpret e-mail messages accurately and write contextually appropriate responses.
- Use English accurately while writing emails in generic professional contexts.
- Use punctuation accurately while writing e-mail messages.

**Assessment (with individualised feedback for mid-course tests):**

- **Mid-course Assessment - 1 hour + 1 hour for feedback after evaluation**
- **Mid-course Assessment - 2 (1 hour + 1 hour for feedback after evaluation)**
- **Final Assessment – 2 hours (inclusive of Email English test)**
Classroom teaching methodology: Concept familiarisation will be accompanied with practice in generic professional emailing contexts. Practice tests and individualised feedback will be used feedback.

Material for the course will be teacher generated

HS5492 PROJECT REPORT WRITING L T P C
3 0 0 3

OBJECTIVES
The Course aims to,
- Develop the project writing skills of engineering graduates
- Give engineering and technology students practice in writing a project report
- Enhance their awareness on the importance of report writing in the professional context

UNIT I

UNIT II

UNIT III
Structure of the Project Report: (Part 1)Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework

UNIT IV

UNIT V
Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report orally – Techniques

TOTAL: 45 PERIODS

OUTCOMES
At the end of the course students will be able to,
- Write reports successfully
- Analyze issues threadbare and arrive at findings based on the analysis
- Write reports for different purposes

REFERENCE BOOKS:
OBJECTIVES
The course aims to,
- Develop public speaking skills among students of engineering and technology
- Enhance the presentation skills of students
- Heighten the awareness related to the fundamentals of presentations

UNIT I
Presentation skills – Characteristics of an effective Oral Presentation – Audience - Context, Content, Speaker Status - Purpose – Modus Operandi – Extempore

UNIT II
Emphasis on syllable stress, pronunciation, intonation, pauses, pace - Preparation for a presentation – Avoiding plagiarism –Ample use of Referencing skills – Efficient ways of Collecting and Collating data (due emphasis on important information)

UNIT III

UNIT IV

UNIT V
Presentation skills – Guidelines – Group Presentation - Creative approaches to presenting – Technical presentation - Speaking under time constraint – variations in pitch, tone & intonation - Credibility in presentation (Use of authentic data/information) Podium panache – Effective Delivery

Learning Outcomes: At the end of the course, students will be able to,

TOTAL: 45 PERIODS

REFERENCE BOOKS:
AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C 2000

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

<table>
<thead>
<tr>
<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>
</tr>
</thead>
<tbody>
<tr>
<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>
</tr>
<tr>
<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></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></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></td>
<td></td>
<td></td>
</tr>
<tr>
<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>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>

REFERENCES

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS


UNIT III DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches
REFERENCES


AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
AX5094 VALUE EDUCATION

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading
OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role.
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

UNIT VI ELECTION COMMISSION:
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading
1. The Constitution of India, 1950 (Bare Act), Government Publication.
OBJECTIVES
Students will be able to:

- Review existing evidence on their view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I    INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II    THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III    EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV    PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V    RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Suggested reading

AX5097  STRESS MANAGEMENT BY YOGA  L T P C  2 0 0 0

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do's and Don’t's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. ‘Yogic Asanas for Group Tarining-Part-I”-Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098  PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS  L T P C  2 0 0 0

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagawd Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagawd Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS
OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi, 2010